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## TRADE LIBERALIZATION AND DIVISION OF LABOR: IMPLICATIONS FOR POVERTY IN CHINA

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ABSTRACT OF DISSERTATION

Xuehua Peng

The Graduate School

University of Kentucky

2006

TRADE LIBERALIZATION AND DIVISION OF LABOR:  
IMPLICATIONS FOR POVERTY IN CHINA

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ABSTRACT OF DISSERTATION

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A dissertation submitted in partial fulfillment of the  
requirements for the degree of Doctor of Philosophy in the  
College of Agriculture  
at the University of Kentucky

By  
Xuehua Peng

Lexington, Kentucky

Director: Dr. Michael R. Reed, Professor of Agricultural Economics

Lexington, Kentucky

2006

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## ABSTRACT OF DISSERTATION

### TRADE LIBERALIZATION AND DIVISION OF LABOR: IMPLICATIONS FOR POVERTY IN CHINA

The concomitance of prosperity and poverty come as an enigma in today's world. As some people in this world benefit greatly from advanced technologies and globalization, others are still suffering heavily from poverty. One noticeable fact is that almost all developing countries have their own distinguished "poor area". Such poor areas seem to persist regardless of robust economic growth enjoyed by the overall economy.

By decomposing the developing country into two regions, one rich coastal region and one poor inland region, this research establishes a new classical general equilibrium 3X2 Ricardian model to investigate how trade liberalization will affect the participation in the division of labor by poor individuals in the inland region in a developing country and their associated welfare change under different trading conditions.

Our model of division of labor on poverty delineates the interdependent relationship between individuals in the poor inland region, the rich coastal region and the developed country. Market integration plays a very important role in such interdependency. Low transaction efficiency is the bottle-neck constraint on the poor

inland region's integration into international division of labor through international trade. Thus, it is critical for the poor inland region to improve the market transaction efficiency in order to enjoy gains from trade.

Our marginal and inframarginal analysis show that as an important part of trade liberalization policy, tariff reduction may not always be a good policy choice for the developing country to alleviate the poverty. Whether tariff reduction makes the inland region better off depends on the initial general equilibrium market structure and the developing country's power of influencing its terms of trade. If the developing country is large enough to determine the terms of trade in international trade with the developed country, the developing country may increase the welfare level of the poor inland region by increasing its tariff rate. But the developed country will oppose it because the tariff rate increase in the developing country will hurt its welfare. Trade negotiation is then necessary to determine the final tariff rate and the share of gains of trade to each country and region.

**KEYWORDS:** Trade Liberalization, Poverty in China, Incomplete Market Integration,  
Inframarginal Analysis, Division of Labor

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Xuehua Peng

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October 10, 2006

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TRADE LIBERALIZATION AND DIVISION OF LABOR:  
IMPLICATIONS FOR POVERTY IN CHINA

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October 17, 2006

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DISSERTATION

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To my beloved wife, Chang Liu  
with many thanks and endless love!

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## CHAPTER ONE

### INTRODUCTION

*“Most of the people in the world are poor, so if we knew the economics of being poor we would know much of the economics that really matters. Most of the world’s poor people earn their living from agriculture, so if we knew the economics of agriculture we would know much of the economics of being poor.”*

-- Theodore T. Schultz, 1980.

#### 1.1 Poverty Challenges In This World

The concomitance of prosperity and poverty come as an enigma in today’s world. As some people in this world benefit greatly from advanced technologies and globalization, others are still suffering heavily from poverty. Their basic needs for living cannot be satisfied. They work hard but still are impoverished by hunger, insufficient shelter, illiteracy, illness and early death. This situation hasn’t changed since Schultz gave his Nobel lecture about the economics of being poor in 1980. The poverty issue remains a central theme of economics.

Current statistics on poverty show that one-fourth of the world’s population (more than 1.2 billion people) are suffering from extreme poverty by living on less than \$1 per day; more than half of the world population (2.7 billion in 2001) live on less than \$2 per day; 1.3 billion have no access to clean water; three billion people have no access to sanitation and two billion people have no access to electricity (World Bank, 2003). The World Food Summit of 1996 in Rome stated that the global poverty population is growing each year by a further 25 million persons in the developing countries. Even though the proportion of people in poverty has

gradually declined during past decades, the absolute number has remained about the same because of population growth. Sustainable poverty reduction has become one of the most important challenges that the world is facing in this new millennium (Aisbett, et al., 2005).

Most people believe that no one should be poor in this world. At the United Nations Millennium Summit in September 2000, the United Nations adopted Millennium Development Goals (MDG) which set an agenda for a war on poverty. MDG include eight specific goals ranging from halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education by the target deadline of 2015. Many countries have made marvelous progress in the battle against poverty in order to assure that poor people can meet their basic living needs. Global poverty rates are falling, especially in Asia. However, millions more people in Sub-Saharan Africa have sunk deep into poverty (United Nations, 2005).

Developed countries have a responsibility to help developing countries to achieve the MDG goals because the whole world is like one body as described in the bible:

“The body is a unit, though it is made up of many parts; and though all its parts are many, they form one body.... But God has combined the members of the body and has given greater honor to the parts that lacked it, so that there should be no division in the body, but that its parts should have equal concern for each other. If one part suffers, every part suffers with it; if one part is honored, every part rejoices with it.”

-- 1 Corinthians 12:12-26, New International Version Bible

As the most populous country in the world, China has provided successful examples of how to fight the worldwide war on poverty. During the last two decades, the People's Republic of China (henceforth China) has made marvelous achievements in rural poverty reduction since the economic reform of the late 1970's. In terms of the official poverty line, China has reduced

its rural poor population from 250 million in 1978 to 80 million in 1993 and further to 28 million in 2002. The percentage of poor people in the rural population has declined from 31 percent to 3 percent (Wang, 2004).

Such progress against poverty has taken place in the context of the third great wave of ‘globalization’ (rising economic openness and integration of national economies)<sup>1</sup>. Thus many international organizations, including the World Bank, the International Monetary Fund (IMF), the World Trade Organization (WTO) and others, claimed that globalization is good for the poor. They are very optimistic about globalization and assert that in the long run open economies perform better than closed economies (Winters, 2002). Thus they have strongly proposed openness and trade liberalization policies to developing countries for the last fifteen years. However, there are growing concerns about possible adverse impacts on the poor and the unequal income distribution which may be associated with trade liberalization policies.

Wade cautioned that we must be agnostic about the poverty headcount (level and trend) because current statistics have serious deficiencies which result in a huge margin for error. Based on the World Bank’s statistics, the falling trend of poverty disappears if we take out China and the poverty trend is clearly increasing if we take out India as well. Therefore, falling income inequality is not a generalized feature of the world economy during this third wave of globalization. The actual poverty numbers are higher than the World Bank’s statistics and the absolute numbers have increased rather than decreased over the past two decades. Even though

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<sup>1</sup> The first wave of globalization was 1870-1914, the second was 1945-1980 and the third was 1980 to the present (World Bank, 2002).

the proportion of the world's population in extreme poverty has fallen in the past two decades, increased world population may have contributed to this plausible trend (Wade, 2004). The association of poverty with progress is still an enigma for today's world<sup>2</sup>.

## **1.2 Issues and Objectives**

A wide range of policies may contribute to China's progress, including fast general economic growth, targeted poverty reduction programs, trade policies, fiscal and monetary policies, and other social and economic policies. It is very challenging to separate the impacts of trade liberalization on poverty from other policies in the empirical study. Thus current research on trade liberalization and poverty may be very likely to exaggerate the impacts of trade liberalization on poverty reduction.

The impact of trade liberalization on poverty hinges on an effective transmission mechanism that moves from the border to the inland. Price movement at the border from trade liberalization affects poor rural farmers in inland regions only if domestic markets are integrated. Without market integration, opening the border does not affect most poor farm communities. Agricultural product and factor markets play a key role in this transmission mechanism. Winters constructed an analytical framework to describe the transmission mechanism through which price changes associated with the removal of border trade barriers are passed through the economic system to affect the welfare of rich and poor households (Winters, 2000). However, most existing literature analyzes the poverty impacts of trade liberalization at an aggregated

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<sup>2</sup> In the 1870s American economist Henry George remarked that 'the association of poverty with progress is the great enigma of our times' (George, 2005).

national level, ignoring the impact of incompletely integrated markets.

The reality in much of the developing countries is that agricultural markets are functioning ineffectively due to poor communications and transport infrastructure, limited rule of law, and restricted access to commercial finance (Barrett, 2005). This means that markets are not spatially integrated within the country. For example, China's markets were becoming less, rather than more, integrated during much of the reform period (Young, 2000).

At issue here is how trade liberalization impacts the poor in remote and inland regions given the condition of incompletely integrated markets within countries. This dissertation research aims to investigate the impacts of trade liberalization on the poor in the remote and inland region in a developing country like China, from a perspective of the division of labor. The approach to tackle this issue is to establish a new classical general equilibrium 3X2 Ricardian model (three region and two products). The advantage of this approach is that it enables us to investigate how the poor in the inland region will participate in the division of labor under different trading conditions.

This research contributes to the literature on trade liberalization and poverty in at least two ways. First, this research aims to build a new classical general equilibrium model to investigate how trade liberalization will affect the welfare of the poor in the inland region given different trading conditions. Individuals in each region will make decisions on what products they should specialize in and then quantities of their production, consumption and trade. We allow for corner solutions in order to investigate multiple general equilibrium situations resulted from different productivity and trade efficiency.

Second, this research provides a framework which may unify all current poverty theories. Any factors affecting poverty (poverty alleviation or poverty entrapment) at the individual, regional, national and international level will change the division of labor in the socioeconomic system and the associated welfare levels. We can incorporate these factors into our model through their impacts on transaction costs.

### **1.3 Structure of this Dissertation**

This dissertation is organized as follows: following this introduction, chapter two provides a literature review on poverty and trade. Then, background information about trade and poverty issues in China is covered in Chapter three. Chapter four establishes a standard 2X2 new classical general equilibrium Ricardian model to analyze the impacts of trade liberalization on a poor developing country. Chapter five extended the model into a 3X2 new classical general equilibrium Ricardian model by dividing the developing country into a rich coastal region and a poor inland region. Chapter six draws some policy implications from the modeling results and highlights some future research directions after some concluding remarks.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1. Theory of Poverty

##### 2.1.1. Concepts of Poverty

Poverty is not an abstract concept but visible and sensate to real individuals and households. One can define poverty in a very descriptive way as a poor man in Kenya did as follows:

*“Don’t ask me what poverty is because you have met it outside my house. Look at the house and count the number of holes. Look at my utensils and the clothes that I am wearing. Look at everything and write what you see. What you see is poverty.  
—A poor man, Kenya 1997” (Narayan, et al., 2000, page 30).*

Poor people have their own understanding about what poverty means materially and psychologically, just as the poor man in Kenya quoted above. The World Bank report series *Voices of the Poor* provided a rich picture of poor people’s experience around the world based on field work in a total of fifty-eight developing and underdeveloped countries. In order to more accurately identify the poor in need and then design and offer the most effective type of help to them, scholars attempt to define poverty more precisely and specifically. The definition of poverty should be helpful in measuring and explaining poverty phenomenon and designing poverty alleviation policy.

Definitions of poverty vary in terms of their narrowness and breadth. However, as argued by Nolan and Whelan (1996), a definition of poverty should not be too broad to run into the danger of losing insight of the distinctive core notion of poverty. Since the creative work on poverty by Amartya Sen, scholars have improved and deepened their understanding of the



concept of poverty. Based on the entitlement approach proposed by Sen, the World Bank provided a general definition of poverty as “inability to attain the minimal standard of living” in its 1990 World Development Report (World Bank, 1990). The World Bank has expanded the dimension of the minimal living standard to encompass not only material deprivation, including food, water, shelter, and clothing, but also low levels of education and health, exposure to vulnerability and risk, voicelessness and powerlessness (World Bank, 1990; 2000). Such a multidimensional approach captures the complete range of deprivation that constitutes poverty, and gives much credence to the views of the poor themselves. However, multidimensional approaches lack the precision and comparability of income/consumption measures which are commonly used by economists.

The definition of poverty refers to the *inability* not the *reality*. For example, a person may have the ability to avoid hunger, but may choose to fast or use limited income to purchase lottery tickets instead. In reality, this individual suffers from hunger (one basic form of poverty). However, he/she has the ability of not suffering from it by changing his/her consumption and expenditure pattern. Thus, this person should not be accounted as poor according to the definition of poverty. However, it may not be easy to distinguish the inability and reality in practice. A definition of poverty in practice may be different from a theoretical definition.

Since poverty results from a combination of economic, social, political and environmental factors, poverty has to be defined in a particular context (Tiemstra, 2004). Tiemstra illustrated this by comparing two societies where everyone made \$1000 in one society while half the people made \$2000 and half made \$20,000 in another society. One may claim that the poor in the latter society may be better off because they have much higher incomes available for their consumption. However, this may not be true. For example, in the former society,

everyone might use the public bus transportation system. In the latter society, many rich people own their private cars. The public bus transportation system may then be crowded out, which makes those people who cannot afford a car worse off. It is luxury for people in developing societies to own a car, while it may be necessary for people in industrialized societies like the United States to own and drive a car in order to escape from poverty (Fletcher, et al., 2002).

Certainly, there is no clear and unvarying concept of universally accepted minimal living standard. Everybody would agree that people need adequate levels of food, clothing and shelter as human beings living in this world. If we assign a fixed absolute real value to the minimal living standard (poverty line), we use a concept of absolute poverty. Absolute poverty measures the number of people who live below the poverty line with a fixed real value or the number of individuals or households unable to afford the minimum living standard. If the poverty line is defined with respect to the population's average level of chosen welfare indicators, we have a definition of relative poverty.

Relative poverty and inequality may cause some social problems such as crime and pollution. Thus, relative poverty may become a drag on economic growth because it increases the cost for government and institutions to deal with such social problems (Tiemstra, 1992). In addition, Ravallion (1997) found that the initial inequality conditions did matter on how much the poor share in rising average incomes. Higher initial inequality tends to reduce the positive impact of growth on absolute poverty reduction and to diminish the adverse impact on the poor of overall contraction. Poverty specifically refers to the lowest quantile in the inequality spectrum those who are not able to attain the minimum living standards. Thus, poverty is closely related to the inequality issue.

Although an absolute poverty concept should, and does, include the relative notion of what constitutes “basis needs” or requirements for a minimal living standard, we must still consider the poverty concept as an absolute notion about people’s living situation in a society (Ray, 1998; Sen, 1983). Even though relative poverty matters to the welfare of the poor, absolute poverty dominates (Ravallion, 1994).

Poverty is also a concept manifesting itself at multiple levels. To get a full picture of poverty, a poverty analysis should integrate macro, meso and micro levels. At the international level, about 900 million, or 75 percent of the world’s poor, live in the Asian and Pacific region, including Central Asia. About one in three Asians is poor. Almost all countries have their own distinguished “poor area” where the incidence rate of poverty is unusually high by national standards. In China, a large number of poor people are clustered in rural areas of the southwest and northwest. Similar situations exist in other countries including some of the eastern Outer Islands of Indonesia, parts of northeastern India, northwestern and southern rural areas of Bangladesh, much of northern Nigeria, the rural Savannah in Ghana, the northeast of Brazil, and many other places (Ravallion and Wodon, 1999). Such poor areas seem to persist regardless of robust economic growth enjoyed by the overall economy.

Poverty also manifests at the meso level such as the county, township and village levels. In practice, we can investigate the poverty situation at the household level by using the available household-level data on expenditure and income. It is found that poverty also manifests itself at the individual level because resources may be unevenly distributed among individuals within a household in terms of gender and age (Atkinson, 1998). To correctly extrapolate the individual poverty situation from household-level data, one should consider the intra-household welfare distribution.

Barrett and Swallow offered an explanation to the fractal poverty trap in which multiple dynamic equilibria exist simultaneously at multiple (micro, meso and macro) scales of analysis and are reinforcing each other through feedback effects (Barrett and Swallow, 2005). Because governments, markets and communities in poor areas characterized by fractal poverty traps are simultaneously weak, small adjustments at any one of these multiple scales alone are unlikely to be strong enough to shift the system away from its dominant, stable dynamic equilibrium of poverty.

Not only the magnitude of poverty but also the nature and duration of poverty matters and differentiates much of the developing world from wealthy countries (Barrett and Swallow, 2005). In wealthy countries, anti-poverty policies largely focus on the provision of safety nets to cushion the poor so that they can stand against temporary shocks or recover quickly. In the developing countries, however, the task of combating poverty is much more challenging. The poor suffer deeply from severe material deprivation and also the feeling of hopelessness induced from such dim prospects (Barrett and Swallow, 2005).

The concepts of chronic poverty and transient (temporary) poverty are used to describe the duration of poverty. Morduch pointed out that the notion of chronic poverty must be complemented by a study of temporary poverty (Morduch, 1994). Jalan and Ravallion distinguish transient poverty (temporary poverty) from chronic poverty in terms of a household's consumption pattern over time (Jalan and Ravallion, 1998). Transient poverty is defined as the poverty attributed to intertemporal consumption variability and chronic poverty is defined as the poverty that persists in mean consumption over time. The degree of transient poverty will differ among areas because households are exposed to different income risks.

There are three main reasons to distinguish transient poverty and chronic poverty. First, transient poverty and chronic poverty should be weighted differently in assessing overall progress against poverty. Second, different types of poverty call for different policies. Policies to increase the human and physical assets of poor people and to increase returns to these assets mainly target chronic poverty. Insurance and income-stabilization schemes are more important policy instruments to fight transient poverty (Lipton and Ravallion, 1995). Thus, knowing the proportion of transient poverty in the currently observed overall poverty may inform policy choices. Third, if the government's objective is to reduce chronic poverty, the government needs to know how much observed overall poverty is transient so that they can prevent resource leakage from the chronically poor to the transiently poor (Jalan and Ravallion, 1998).

#### 2.1.2. Measurements of Poverty

Since researchers disagree on the definition and the methodology to measure poverty, there exists no consensus on measurements of poverty (choices of poverty line and poverty measure). Bowley proposed a head count measure of poverty in the early 1920s (Bowley and Hogg, 1925). Since then, subsequent researchers proposed many alternatives to measure poverty.

Sen stated that the poverty measurement problem must include two distinct but related exercises, that is, identification of the poor and aggregation of poverty (Sen, 1981, 1976). Identification of the poor tries to answer who and where the poor are and aggregation of poverty attempts to aggregate the characteristics of the set of poor people into an overall image of poverty. In the money-metric approach, we can specify a subsistence income (expenditure) level as the poverty line and classify individuals with lower incomes (expenditures) than the poverty line as the poor. The poverty line indicates the minimum level of “acceptable” economic

participation in a given society, or community, at a specific time point (Ray, 1998). For a non-money metric approach, we can apply the same method to specify a corresponding poverty line to measure if an individual is poor.

An income of \$1 per day per person has become the international benchmark for poverty measurement in developing countries. This international poverty line was established according to studies on some 33 countries in the 1980s, expressed in purchasing power parity (PPP) of 1985 (Ravallion, et al., 1991). It has been updated using an expanded set of PPP values at 1993 prices and the new international poverty line is \$1.08 (World Bank, 2000). The PPP version of the international poverty line has some flaws and technical issues, which affect the reliability of global poverty trends measured by it (Vandemoortele, 2002, Wade, 2004).

Among aggregate measures of poverty, the head count index is the most popular one used by economists and policymakers because of its simplicity. It measures the proportion of persons with incomes less than the poverty line. Another popular poverty measurement is the income gap ratio which is defined as the ratio of the gap between the poverty line and average income of the poor, expressed as a proportion of the poverty line. The poverty gap index captures the depth of poverty and indicates the potential cost of eliminating poverty by targeting transfers to the poor (Ravallion, 1992). However, both the head count index and income gap ratio share the same drawback of ignoring inequality among the poor.

Sen (1976) proposed two appealing axioms for a poverty measure to consider the income distribution among the poor:

(1) Monotonicity axiom. Given other things, an income reduction of a person below the poverty line must increase the poverty measure.

(2) Transfer axiom. Given other things, a pure income transfer from a person below the poverty line to anyone who is less poor must increase the poverty measure.

The best known measures addressing the income distribution among the poor is the Foster-Greer-Thorbecke (FGT) class proposed by Foster et al. (1984). The FGT class of poverty measurement is defined by

$$P_{\alpha} = \frac{1}{n} \sum_{y_i < p} \left( \frac{p - y_i}{p} \right)^{\alpha} \quad (2.1)$$

where  $y_i$  denotes income (or expenditure) of individual  $i$ ,  $p$  denotes the poverty line,  $n$  is the total population. Power  $\alpha$  can be any value. For  $\alpha = 0$ , the measure  $p_0$  is reduced to the head count index. For  $\alpha = 1$ , the measure  $p_1$  is reduced to the poverty gap index.

The “best practice” in poverty measures is to adjust for differences in the prices faced and household demographics. Even though the headcount index has received trenchant critiques, it remains very popular because of its rationale and simple formula. From the policy perspective, the means of setting poverty lines may matter more because they determine the interpersonal welfare comparisons and thus construct the resulting poverty profile (Ravallion, 1996). Unfortunately, many methods used in practice may not guide policies in the right direction. For example, the poverty lines used as deflators do not account well for the cost-of-living differences facing the poor without considering spatial price differences (Ravallion, 1994). It may be irrelevant for anti-poverty policies to set poverty lines as a constant proportion of the mean consumption or income for each subgroup or time period because no implications can be drawn about the absolute levels of living.

Poverty indicators, such as poverty head counts, might change significantly due to changes in poverty measurement methodology without any real change in the well-being of the

population. Schelzig uses two surveys from Mongolia and Philipines to show that a seemingly slight variation in survey methodology can have a rather significant impact on poverty results (Schelzig, 2001). Thus, Schelzig suggests assessing poverty from a purely economic statistical approach toward multidisciplinary approaches.

A single indicator cannot measure everything. In a multiple-indicator approach, we need to know what each indicator is measuring and why we use it. Four categories of indicators may be used (Ravallion, 1996):

(1) A sensible poverty measure based on the distribution of real expenditures per single adult considering all goods and services from market and non-market sources.

(2) Indicators of access to non-market goods and services such as access to education and health services.

(3) Indicators of welfare distribution within households; measures of gender inequalities and child nutritional status.

(4) Indicators of impacts of certain personal characteristics, such as physical handicaps and impairments, on the ability of escaping poverty.

However, a multidimensional approach to poverty measurement is much more complex than a univariate approach. A so-called poverty dominance method is proposed for the purpose of multidimensional poverty measurements and comparisons<sup>1</sup>. Different contexts demand different indicators. To assess the poverty effects of external trade liberalization, which is the focus of our research, it is appropriate to focus on income (consumption) poverty measures.

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<sup>1</sup> For detailed discussion on multidimensional poverty measurements, see Atkinson and Bourguignon (1982, 1987), Bourguignon and Chakravarty (2003), and Duclos and Makdissi (2005).



### 2.1.3. Causes of Poverty

There are two basic approaches to explain the causes of poverty: the aggregate approach and individual approach. Traditional development economics and macroeconomics belong to the first approach which investigates poverty at an aggregate level. Economic development is necessary for poverty alleviation. Thus, development economics explains poverty from economic growth and development.

Early development theorists identified capital formation as the crucial component to accelerate development (Rosenstein-Rodan, 1943; Nurkse, 1953, 1967). For most poor developing countries, where domestic savings rate was typically low, there is a basic “bootstrapping” problem. Low levels of existing capital stock in developing countries hinder capital formation. The old saying “it takes money to make money” applies to many poor developing countries. Lewis’s dual economy theory (1954, 1955) precisely stressed the role of savings in development. The Keynesians argued that government intervention can manipulate savings. Indeed, Rosenstein-Rodan (1943) argued that increasing returns to scale made government-directed industrialization feasible. Singer (1964) and Myrdal (1970) reiterated that government intervention could turn “vicious circles” of low savings and low growth into “virtuous circles” of high savings and high growth. Thus, government involvement - whether by planning, socio-economic engineering or effective demand management - was regarded as a critical tool of economic development.

Although capital-formation never really left the field, the meaning of the term mutated somewhat over time. T.W. Schultz, a Nobel prize laureate in economics, turned away from physical capital accumulation to emphasize the need for “human capital” formation (Schultz, 1980). This led to an emphasis on education and training as prerequisites for growth and

development and the identification of the problem of the "brain drain" from the Third World to the First (and from the private sector to government bureaucracies). Lewis and Singer extended Schultz's theory by arguing that social development as a whole - notably education, health, fertility, etc. - by improving human capital, was also a necessary prerequisite for growth.

Since 1969, Dudley Seers pioneered the shift of development economics theory from economic growth to economic development (Seers, 1969). Seers argued that economic development was a social phenomenon that involved more than increasing per capita output. The purpose of development is to eliminate poverty, unemployment and inequality. Seers commented:

“What has been happening to poverty? What has been happening to unemployment? What has been happening to inequality? If all three of these have become less severe, then beyond doubt this has been a period of development for the country concerned. If one or two of these central problems have been growing worse, especially if all three have, it would be strange to call the result “development,” even if per capita income has soared.”

(Seers, 1969, pages 3-4)

Singer, Myrdal and Adelman acknowledged the validity of Seers' complaint. Thus, structural issues such as dualism, population growth, inequality, urbanization, agricultural transformation, education, health, unemployment, etc. all began to be reviewed on their own merits, and not merely as appendages to an underlying growth thesis.

In contrast to an aggregate approach, many economists examine poverty from an individual approach. Sen views poverty as individuals' incapacities to achieve states of living. Sen focuses on a number of basic “functionings” central to an individual's wellbeing, such as being adequately nourished, avoiding premature mortality, appearing in public without shame, being happy, and being free (Sen, 1985, Sen, 1981). Sen's approach has become the foundation of the World Bank's poverty research.

In addition to development economics theories, other theories are developed to explain the causes of poverty. For example, geographic conditions are also recognized as important factors affecting poverty. Gallup and Sachs used cross country and cross region data to show that the countries with favorable geographical conditions for transportation have better development performance (Gallup, et al., 1999). Poverty has a geography in three senses: (1) the spatial distribution of people poverty; (2) place poverty; (3) the lived experience within the physical and social space of a common community. The geographic attributes of a region determine the environment context that helps or hinders economic development. Places that are more isolated or that have fewer natural advantages are likely to have fewer economic opportunities, leading to smaller local industry and more economic difficulties. A focus on places bridges the gap between the concepts of poverty and social exclusion (Powell, et al., 2001).

Durlauf (1999) developed a membership theory of poverty to analyze how socioeconomic groupings (aggregate level) affect individuals' poverty situation. In membership models, individuals are identified into distinct groupings and assumed to be strongly influenced by groups such as the residential neighborhood in which they grow up, the schools they attend, and even their coworkers (Durlauf, 2006, 1999). The formal theory underlying membership models has important implications for the integration of different disciplines in social science into a unified framework on poverty (Blume and Durlauf, 2001).

According to the social capital theory, economic failure has cultural roots with it. It would be extremely naïve to think that a prescription of pure economic policy alone could have a strong enough impact to break the vicious circle whereby poverty and exclusion from society are reproduced and poverty is perpetuated from one generation to the next (Ocampo, 2004).

In summary, poverty is not only an economic issue but also a societal issue. Poverty is not only an aggregate macro level issue but also an individual micro issue.

## **2.2. Relationship between Trade Liberalization and Poverty**

### **2.2.1. Analytical Framework**

Since the early 1950s, the relationship between trade and development has been an important policy issue. However, only recently has the relationship between trade and poverty been a subject of intense interest. Most policy-oriented poverty analysis before the 1990s ignored the influence of international economic relationships on poverty. Many economists believed that trade liberalization policy involving tariff reduction was a powerful engine of economic development (Krueger, 1997; World Bank, 1997).

The World Bank placed the poverty reduction problem in a global context for the first time in its World Development Report 1990 (World Bank, 1990). In 1996, UNCTAD provided the first estimate of the impact of the international trade regime on poverty in developing countries (UNCTAD, 2004). In the last few years, there has been a proliferation of research on the subject of trade and poverty.

Figure 2.1 summarizes issues related to the field of trade and poverty. As Figure 2.1 shows, the relationship between trade liberalization and poverty is only a subset of various policy issues related to trade and poverty. Specifically, these policy issues include (1) the effects of primary commodity dependence; (2) the balance-of-payments constraint on poverty reduction; (3) the relationship between export and import instability and vulnerability; (4) the relationship between upgrading the composition of exports towards higher-quality and higher-skill products and the social exclusion of poorer producers from livelihoods; (5) bargaining power in global

production chains and the distribution of gains from trade; (6) how the development of non-traditional exports affects gender relations; (7) the effects of trends in, and variability of, the terms of trade on poverty; (8) the relationship between trade and employment; and (9) the relationships between trade and inequality.

Current research on trade and poverty narrowly focuses on trade liberalization and poverty. The great merit of the current work on trade liberalization and poverty is that it is very good at understanding the direct impact on poverty of changes associated with trade liberalization. The current approach is less good at understanding the indirect impact of a country's wide range of trade policy changes on poverty (UNCTAD, 2004).

Winters and others constructed an analytical framework to identify the various channels at the national level through which price changes associated with trade liberalization are "passed through" the economic system to influence the welfare of richer and poorer households (McCulloch, et al., 2001, Winters, et al., 2004). As shown in Figure 2.2, trade policy reform is seen as a price shock which has (1) expenditure effects, which arise because of changes in the prices of consumption goods; (2) income and employment effects, which arise because of changes in the remuneration of production factors; (3) effects on changes in tariff revenues and taxes, which affect transfers and the provision of public goods, as well as affecting the risk and uncertainty that poor households face due to a rise in short-term and medium-term adjustment costs. This framework integrates the macro level and household level. New methodologies have been proposed to empirically investigate the links between trade and poverty using this general framework. However, the ongoing methodological work on trade liberalization and poverty is generating ever more technically complex models which in turn spawn their own empirical and methodological controversies (UNCTAD, 2004).

### 2.2.2. Analysis on Trade Liberalization and Poverty

There have been debates on trade liberalization and poverty in developing countries for years. Some observers have argued that trade liberalization benefits the poor in developing countries while others argue that the benefits are seized only by those who are not particularly poor. The methods to tackle this issue empirically can be divided into five broad categories: cross-country comparisons, aggregate time series analyses at the country level, partial equilibrium or cost-of-living analyses, general equilibrium analyses and general equilibrium micro-simulation analyses<sup>2</sup>.

A large body of literature using cross-country comparisons does not have consensus on the impact of trade openness on poverty within countries. Dollar and Kraay (2001) used a sample of six globalizing countries, China, India, Brazil, Thailand, Argentina and Bangladesh, to study the relationship among the trade liberalization, growth, and national poverty. All these countries sharply reduced tariff rates in the 1990s and thus increased international trade in terms of trade value and its ratio to GDP. Their findings suggested that trade liberalization tended to be associated with accelerated growth and poverty reduction in the 1990s. In 2002, Dollar and Kraay used a larger sample of developing countries to show that trade liberalization benefited the poor to the same extent that it benefited the whole economy (Dollar and Kraay, 2002).

Despite difficulties in distinguishing between correlation and causation in such cross-country regression analysis and the challenge of robust specification tests (Rodrik, 2000), the cross-country regression approach can provide much more general conclusions than the country-specific simulation models.

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<sup>2</sup> The various methods used in the literature and the findings of past researches are discussed in the useful surveys by McCulloch, et al., 2001; Reimer, 2002; Ravallion, 2004.

Ravallion (2004) uses aggregate time series data on China from 1980 to 2000 to test the claim that China's greater openness has been an important factor in reducing poverty. Both current and lagged trade volume are found to have an insignificant impact on poverty in China. Their research casts doubt on the view that greater openness to external trade in China has been the driving force in poverty reduction. Many "non-trade" factors appears to have played an important role in China's success in poverty alleviation.

The third general approach to estimate the poverty impacts of trade liberalization is partial-equilibrium/cost-of-living analyses. Litch et al. (2003) use a partial equilibrium approach to examine the impacts of agricultural trade liberalization on poverty in three developing countries, Vietnam, China and Zambia. A discrete-time proportional odds model is estimated for China. Huang et al. (2003) use their own partial equilibrium model, the China Agricultural Policy Simulation (CAPSIM), to assess the impacts of trade liberalization. Based on eleven income groups in three regions in China, they disaggregate the data into thirty-three groups ( $11 \times 3 = 33$ ). They find that farmers in all regions and all income categories will benefit from trade liberalization on average while the richer farmers in coastal areas will benefit more than poorer inland markets.

The general equilibrium approach has been used in welfare analysis of trade liberalization. The advantage of the general equilibrium approach is that it can assess the impact of economic shocks which reverberate across sectors, regions of a country or even the world. Anderson et al. (2004) use the GTAP (Global Trade Analysis Project) version 5 to assess the impact of China's WTO accession on farmer incomes. In contrast to Huang et al.'s partial equilibrium study, this research finds that the incidence of rural non-farm poverty will fall mainly because of the growth in wages for unskilled workers in rural non-farm activities. Poverty may well increase in

agriculturally based hinterland provinces a long way from markets and in regions poorly served with the necessary infrastructure.

The fifth general approach to assess the impact of trade liberalization on poverty is computable general equilibrium with micro-simulation analysis. In essence, this approach is a sequential two-step simulation model. A general equilibrium model is first shocked to obtain commodity and factor price changes, and then these prices are fed into or calibrated to a post-simulation framework that calculates the effects on actual or highly disaggregated representative households.

Robilliard et al. (2001) build a general equilibrium model based on a single-region Social Accounting Matrix that captures macroeconomic constraints along with intersectoral flows in Indonesia. The post-simulation analysis is then conducted with survey data on 33,000 individuals in 9,800 households. Hertel et al. (2004) use a similar approach to find that multi-lateral trade liberalization will reduce overall poverty in Indonesia, Philippines, Uganda, and Zambia, but increase overall poverty in Brazil, Chile, and Thailand. However, to our knowledge there is no work yet that looks at trade and poverty using such a two-step CGE micro-simulation model.

With the development of research methodology used in trade and poverty, little attention has been paid to the incomplete market integration. Beghin and Fang (2002) argue that there is measurement bias in comparative advantage analysis in the presence of incomplete market integration.

McCulloch et al. concluded that the links between trade liberalization and poverty are very country-specific (McCulloch, et al., 2001). Empirical studies showed that trade liberalization reduced the absolute poverty rate in some countries while increased it in other



countries. However, McCulloch et al. did not answer what factors determined the specific relationship between trade liberalization and poverty in a specific country.

### **2.3. Evolution of Division of Labor and Poverty Alleviation**

In neoclassical economics, economies of scale are considered as the most important driving force for economic growth (Dixit and Stiglitz, 1977; Ethier, 1979; Krugman, 1979; Romer, 1990). Young argued that the notion of economies of scale captured the quantitative aspects but missed the qualitative aspects of economies from division of labor. He explained:

“The mechanism of increasing returns is not to be discerned adequately by observing the effects of variations in the size of an individual firm or of a particular industry, for the progressive division of labor and specialization of industries is an essential part of the process by which increasing returns are realized. What is required is that industrial operations be seen as an interrelated whole.” (Young, 1928, page 539).

Suppose in a society consisting of three *ex ante* identical individuals (A, B and C) who prefer diverse consumption and specialization in production of three goods  $x$ ,  $y$  and  $z$ . If individual A chooses to completely specialize in producing good  $x$ , he will demand goods  $y$  and  $z$  from the market. The other two individuals (or at least one of them) must specialize in producing goods  $y$  and  $z$  and selling them to individual A. If individual A chooses self-sufficiency of goods  $x$  and  $y$  but produces no good  $z$ , he will demand good  $z$  from the market. At least one of the other two individuals needs to specialize in producing good  $z$  and selling them to individual A. If two individuals (A and B) choose self-sufficiency of all goods, then individual C cannot choose specialization. Therefore, each individual's decision as to his own level of specialization not only determines his own productivity, but also determines the extent of the market for the produce of others, thereby imposing a constraint in their decisions on their levels of specialization and

productivity (Yang, 2001). Young summarized such features of the network effects of the division of labor and the related market in the Young theorem:

“the securing of increasing returns depends on the progressive division of labor ... not only the division of labor depends upon the extent of the market, but the extent of the market also depends upon the division of labor ... demand and supply are two sides of the division of labor.” (Young, 1928, page 539)

In other words, division of labor is the source of increasing returns and economic development. Division of labor among individuals is connected through interactive transactions among individuals and thereby weaves a huge economic network. However, every transaction incurs costs. There is a trade-off between economies of division of labor and transaction costs. On the one hand, the positive network effects of division of labor on aggregate productivity encourage more transactions and further expand the economic network. On the other hand, transaction costs place constraints on the evolution of the division of labor. Increases in transaction costs will hinder the improvement in the division of labor and reduce transaction behaviors between individuals. Decreases in transaction costs will promote benefits in division of labor through more transactions among individuals.

New classical economics integrates the division of labor and transaction costs and may provide a more powerful explanation for the mechanisms of economic development. We can also apply this new classical economics approach to poverty analysis. The economic development level of poor countries and poor regions within a country is determined by the degree of division of labor in the social economic network. Individuals' poverty situation is affected by the extent that they participate in the division of labor. Trade liberalization will not only affect regional and individuals' resource allocation, but also the division of labor between countries, regions and individuals.

Trade plays an important role in poverty alleviation by affecting the division of labor between countries, regions and individuals. Sen recognized the importance of trade in poverty alleviation in his entitlement approach where he defined trade as the exchange entitlements with others (Sen, 1981):

“...it is quite possible that severe famine conditions can develop for reasons that are not directly connected with food production at all. The entitlement approach places food production within a network of relationship, and shifts in some these relations can precipitate gigantic famines even without receiving any impulse from food production.

It is not my purpose to deny the importance of food production, or of some of the well-analysed issues in international food policy. It *is* rewarding to consider international insurance arrangements to reduce the food supply vulnerability of particular countries. It *is* relevant to know international food aid affects domestic production and distribution, and the world food prices. It *is* also useful to do food balance sheets and integrate them into social account procedures, and to go into more elaborate analysis of ‘food systems’. The focus that emerges from this monograph looks at a different direction, namely the need to view the food problem as a relation between people and food in terms of a network of entitlement relations.”

(Sen, 1981, page 158-159).

However, modern international trade theory takes a biased approach to analyze the international equality problem instead of the reality of underdevelopment. As Myrdal criticized,

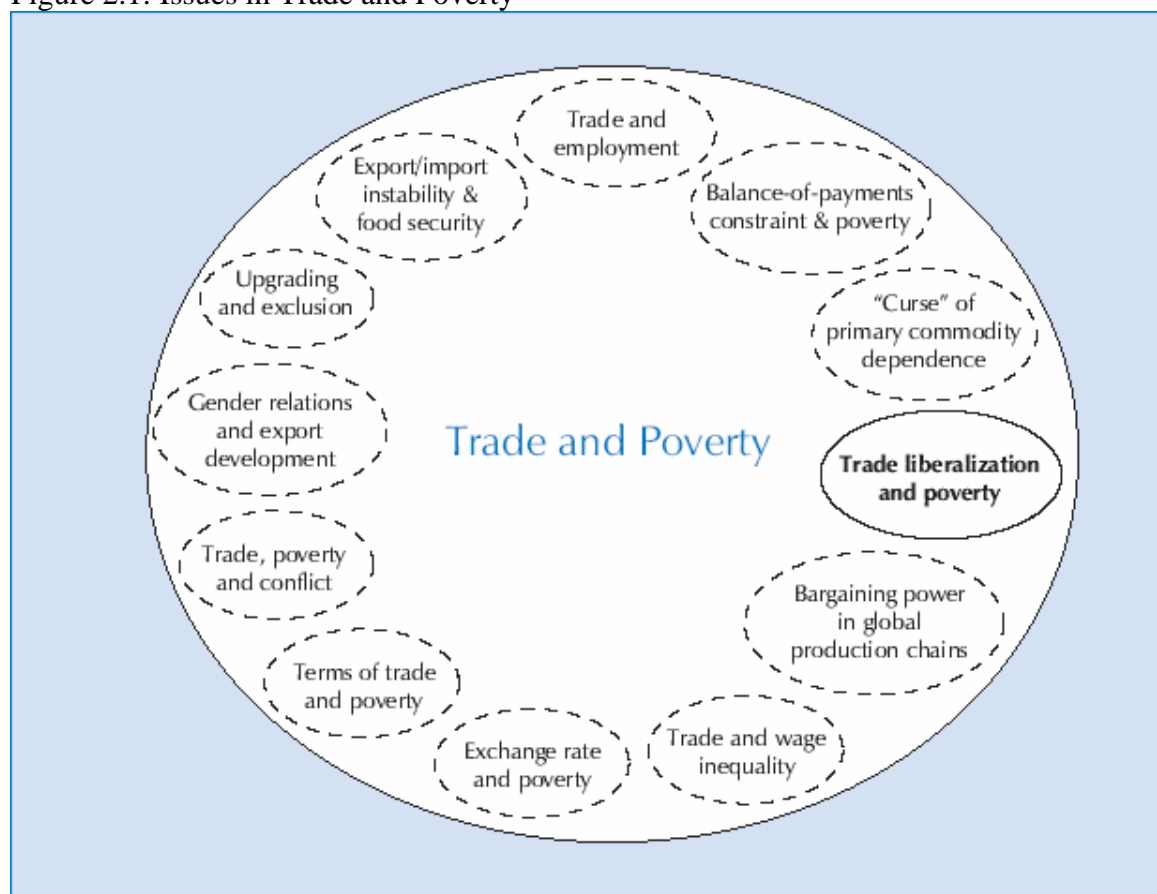
“When applying an immanent criticism to the theory of international trade, the biased approach it implies stands out in the unrealistic assumption of stable equilibrium – and a number of other assumptions related to that assumption. Even in later writings, it has been retained more tenaciously than in other parts of economic theory. Another unrealistic assumption is the notion that there are certain elements of social reality which can be characterized as the ‘economic factors,’ and that it is defensible to analyze international trade while abstracting from all other factors.” (Myrdal, 1970, page 277).

From these flawed assumptions, international trade theory mis-predicts about the effects of international trade and capital movements. Myrdal continued:

“Biased in this way, the international trade theory developed a thought that trade worked for the equalization of factor prices and incomes, in the first instance wages of labor. Trade would permit industrial activity to adapt itself to the location of natural and population resources in different countries and different regions, and this would have a generally equalizing effect on incomes everywhere.” (Myrdal, 1970, page 277).

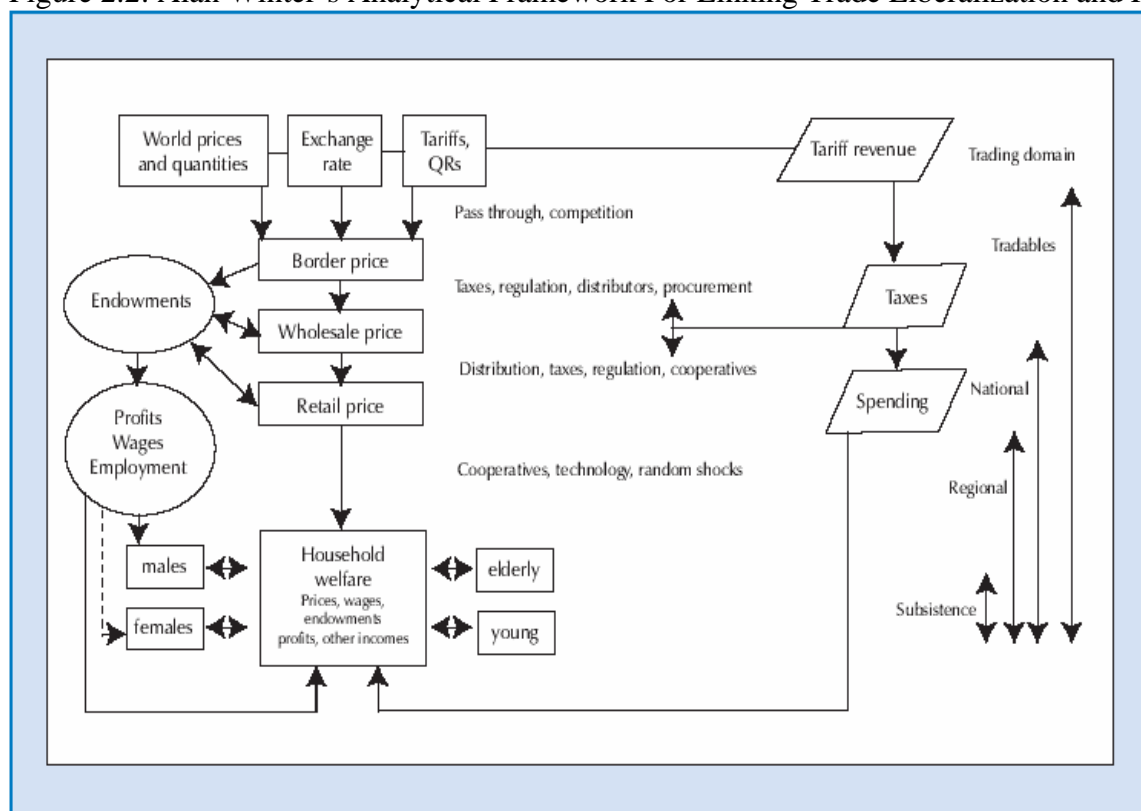
Contrary to the predictions from traditional trade theory, the observed fact is that international trade and capital movements generally tend to allow inequality to thrive (Myrdal, 1970). In the next section, we will apply the new classical economics approach to analyze the poverty impacts of trade liberalization.

Figure 2.1: Issues in Trade and Poverty



Source: UNCTAD, 2004

Figure 2.2: Alan Winter's Analytical Framework For Linking Trade Liberalization and Poverty



Source: Winters, 2002

## **CHAPTER THREE**

### **CHINA'S POVERTY IN THE GLOBAL CONTEXT**

#### **3.1. Poverty in China**

The poverty reduction in China has been the most dramatic in history. Around 1980, China was still a country with the highest incidence of extreme poverty in the world. Through development over the past two decades, China has made tremendous achievements in reducing rural poverty. Nowadays China has a poverty rate slightly lower than the world average poverty rate. According to China's official poverty line, the absolute poor population dramatically decreased from 250 million in 1978 to 128 million in 1984. After slowing in the late 1980s, the rapid decline in the poverty head count resumed in 1990s, decreasing to 26 million in 2004, and the poverty-stricken population as a proportion of the total rural population sharply decreased from 31% in 1978 to 15.1% in 1984 and then to 3% in 2002 (see Figure 3.1).

Using the universal international poverty line developed by the World Bank, one can find higher levels but a similar trend in China's poverty reduction. Noticeably, China uses different poverty lines at different time periods. China did not define any poverty line until the Chinese government launched a massive antipoverty program in 1985. The absolute poverty line was established at 300 Yuan per capita per year in 1990, reflecting the income required to meet minimum nutritional requirements (2,100 calories per day) and nonfood requirements and corresponds to about \$0.70 per day in 1985 PPP dollars. The higher poverty line is set at 454 Yuan (in 1990 prices) equivalent to \$1.00 per day in 1985 PPP dollars. Both of these measures

are below the World Bank standard of \$1.00 per day (in 1995 PPP dollars) of consumption expenditure. The Chinese definition of absolute poverty is the basis of the discussion unless otherwise indicated<sup>1</sup>.

### *Three Stages in China's Poverty Alleviation History*

China's poverty alleviation can be divided into following three stages:

The first stage is the rapid progress period from 1978 to 1985. During this period, the Chinese government took several measures to attack poverty. Specifically, there were four types of reforms which significantly enhanced the effects of participatory agricultural growth on poverty reduction. The first one was land reform and widespread decollectivization. Essentially, the Chinese government abandoned the centralized system of communal farming and began to introduce the "household responsibility system" which provided a strong foundation for the success of China's economic reform. Chinese farmers were entitled to the freedom (and responsibility) for most of their farming activities so that they could make their own production and market decisions. Meanwhile, they were no longer bound to "Grain First" policies and strictly fixed grain quotas, which often forced them to participate in unproductive cultivation. Empirical studies showed that the total factor productivity in the household system was improved about 20% to 30% compared with that in the old collective system (Wen, 1993). The productivity growth contributed 54% of the output growth and 97% of the productivity growth stemmed from the change in farming institutions from collectivization to the household

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<sup>1</sup> There are different sources of bias with China's official poverty estimates. It is necessary to look at other estimates using alternative methods and data sources. More detailed discussion on China's poverty level can be found in Chen and Ravallion (1996).



responsibility system (Lin, 1996). The second was market-oriented reform. The Chinese government cut the grain procurement quota and decreased the number of planned product categories which were controlled by the government's plan. Restrictions on interregional agricultural trade were lifted and private traders were allowed and encouraged to participate in interregional trade.

The third was price reform. The Chinese government increased procurement prices for major crops, which directly contributed to output growth and income increases in rural China. The price reform was estimated to contribute about 16% of the output growth and 20% of the rural per capita income increase in 1978-84 (Lin, 1996). The fourth was migration policy. The Chinese government began to relieve some controls on migration and allow millions of rural residents to move temporarily or permanently to towns or cities in 1982. As a consequence of fundamental policy changes during this period, China's food supply greatly improved and the rural areas began to develop. Agricultural and rural income grew faster than the average national income. Special grant funds and initiatives to spur growth were also directed to poor areas. The poverty rate was dramatically reduced.

The second stage is the temporary setback period from 1986 to 1993. The government started to implement a series of formal poverty alleviation programs. The regional focus of the program was "the old revolutionary power base (usually economically backwards)" as well as "regions of national minority populations". Institutionally, an office of the Leading Group for Economic Development in Poor Areas (LGEDPA) was established at the national level to monitor the expenditure of the poverty funds, coordinate efforts to alleviate poverty across a

number of sectors and be an advocate for the poor. Under this national organization, Poor Area Development Offices (PADO) were established at the provincial and county levels to administrate poverty funds from national and provincial sources (Tong, et al., 1995). However, as the one-time explosive impacts of the introduction of the household responsibility system and other agricultural policy changes ceased, agricultural and rural growth began to slow down. Meanwhile, China's development strategy shifted from an agriculture-led development strategy to an export-led industrialization development strategy. Under the principle of "Let some people and regions become rich first and then lead all become rich", coastal provinces and cities received favorable supports through public investment and fiscal incentives. This left the central and inland regions with fewer resources for development. The regional disparity began to increase and poverty reduction was set back during this period.

The third stage, from 1993 to the present, resumed the progress in poverty reduction, although not as rapidly as during the first period. Responding to the reduced pace of poverty reduction in late 1980s, the Chinese government launched a targeted intervention program in 1994 which was widely known as the 8-7 Poverty Reduction Program. The aim of this program was to "have basically eliminated absolute poverty throughout China by the year 2000." The 8 (for 80 million people) 7 (for the 7 years to the program ending year 2000) program set an objective to lift the 80-100 million remaining poor out of poverty by the year 2000. In this program, the Chinese government made a strong commitment to poverty reduction as well as education and health care. The number of poor people escaping from poverty rose to five million a year, compared with only 2.5 million in the late 1980s and the early 1990s (Zhang, 1997).

### *Regional Poverty Differences in China*

The gains from past reforms were not distributed evenly among regions. There existed regional divergence and the poor in inland regions have gained very little during China's high economic growth period (Chen and Ravallion, 1996; Diao, et al., 2003; Wang, 2004). Moreover, regional inequality has been enlarged over the past two decades (Kanbur and Zhang, 1999). With China's entry into WTO, the poor inland regions may lag further behind if the Chinese government cannot develop and implement proper development policies. Thus the rural poor may increasingly concentrate in these regions (Diao, et al., 2003).

Table 3.2 reports the poverty incidence rate at the provincial level in different years. As we can see from Table 3.2, there were eight provinces (Henan in Northern China, Shaanxi, Ningxia, and Gansu in Northwestern China, Guangxi, Sichuan, Guizhou and Yunnan in Southwestern China) with a surprisingly high poverty incidence rate greater than 20% in 1985. Ningxia had the highest poverty incidence which was 53%. Meanwhile, there were seven provinces (Beijing and Tianjin in Northern China, Jilin in Northeastern China, Shanghai and Jiangsu in Yangze River area, and Guangdong in Southern China) with an almost zero poverty incidence. Most regions have seen significant improvement in their poverty situation over the past two decades. In 2001 only five provinces (Inner Mongolia, Ningxia and Qinghai in Northwestern China and Guizhou and Tibet in Southwestern China) had a poverty incidence rate over 10%. Clearly, the highest poverty incidence regions clustered in the northwest and southwest.

Arresting achievements of China's overall poverty reduction cannot mask the fact that pockets of severe poverty still exist in China's rural areas, especially in central and western rural China. The spectacular economic growth in the coastal regions did not spill over to the poor inland regions. The poorer inland regions tend to grow more slowly than the richer coastal regions (Heilig, et al., 2005).

*Disadvantages and Advantages for the inland region in China*

Disadvantages in geographic conditions are usually considered as an important cause of poverty in the underdeveloped region (Diamond, 1997; Gallup et al., 1999; Sachs, 2001). Heilig et al. provided a comparison of selected characteristics between the poverty region and the non-poverty region at the county level in China. As shown in Table 3.3, over 72 percent of poverty counties on average are at slopes above eight degrees, in contrast to 36 percent of non-poverty counties. On average, poverty counties have a higher altitude and lower rainfall and temperature than the non-poverty counties have. Data in Table 3.3 shows that the poverty counties have much harsher natural conditions than non-poverty counties.

As a result of the harsh natural conditions, agricultural productivity in poverty counties is much lower than that in non-poverty counties. For example, the average grain yield in poverty counties is 3,399 kg per hectare versus 4,896 kg per hectare in non-poverty counties. Basic infrastructure facilities (such as roads, telephone, water, and hospital beds) cover much fewer residents in poverty counties than in non-poverty counties. Poverty counties also have less educated human resources. The percentage of the illiterate population in poverty counties is as twice as high as that in non-poverty counties, while the percentage of population with a college

degree in poverty counties (0.19%) is as low as one fourth of that in non-poverty counties (0.75%). The low productivity and poverty status may reinforce each other.

The geographical disadvantages of distance, altitude, landform, and climate, as well as the economic disadvantages (such as small market size, distance to market center, poor infrastructure) provides much of the explanation for poverty in China's inland region. However, one should be aware that the inland region in China has very rich and excellent natural, humanitarian, ecological and protogenic resources. If the poor inland region in China can promote a development strategy based on these resources advantages, the inland region may have the opportunity to escape from underdevelopment.

#### *Official Institutional Structure of China's Poverty Alleviation*

The State Council authorizes the Leading Group for the Economic Development of Poor Areas (LGEDPA) to coordinate poverty measurement and research, project planning and monitoring, and management of both domestic and international funding for poverty reduction. The anti-poverty executive agency and the Poor Area Development Office (PADO) report to the State Council via LGEDPA (see Figure 3.1). Within the Leading Group orbit, the State Council also funds four other anti-poverty units including the China Development Foundation for Poor Areas (DFPA), the Cadre Training Center (CTC), the Training Center Office (TCO), and the Economic Development Service Center (EDSC). After the central model, every province, prefecture and county has established their own Leading Groups and PADOs and many townships have a "designated person" to handle anti-poverty work. The Agricultural Bank of China, the National Planning and Development Commission, and the Ministry of Finance are

also intensively participating in poverty alleviation. In addition, many other agencies, enterprises and institutions at the central government and provincial levels are playing an active role in poverty alleviation in China (Zhang, 1997).

#### *Targeting of China's poverty alleviation*

In order to make efficient use of limited poverty alleviation funds, the Chinese government designated some key national and provincial poverty counties and gave them special support. The initial list of key national poverty counties was announced in 1986 and included 258 key counties in 17 provinces and autonomous regions. The basic selection criterion is that the average net income per capita of all rural residents within the county in 1985 should be less than 150 Yuan. However, among the 258 poor counties, only 83 counties met this criterion. another 82 counties have an average income per capita between 150 and 200 Yuan, and the other 93 counties between 200 and 300 Yuan. This implies that the selection of key national poverty counties was highly political (Wang, 2004).

The LGEDPA has adjusted this list several times since then. However, many counties strongly oppose being dropped from the new list because the selected key poor counties enjoy various allowances and access to resources. Therefore, few were removed from the list while many new ones were added. As a result, some “rich ” key national poverty counties emerge after they successfully escape from the vicious poverty trap. In 1994 The LGEDPA expanded this list to include 592 key national poor counties. The latest version of this list is the one readjusted in 2001 which also includes 592 key national poor counties. However, the focus of this list shifted further to the central and western provinces. All the poor counties in the coastal regions listed in

1993 were eliminated from the new list. The provincial governments in these coastal regions need to take full responsibility for poverty reduction.

Figure 3.3 shows the distribution of these key counties and 74 counties of Tibet which are also included in the large-scale integrated government action to combat poverty. These key counties are concentrated in a poverty belt that stretches from the Northeast to the Southwest and from central China to the far western province of Southern Xinjiang. Among these 592 key poverty counties, 65% or 384 counties are in mountainous areas. 90% of the 55 minority-ethnic populations are in the poverty regions covering five minority autonomous regions, 24 autonomous states and 44 autonomous counties. Minority-ethnic population accounts for 9% of China's total population and 40% of national extreme poverty.

Available evidence indicates that the selected key poor counties are slightly poorer than the national average. However, county-based regional poverty targeting is no longer efficient. First, key counties covered only 54% of the poverty population and 57% of low-income population in China<sup>2</sup> (Jalan and Ravallion, 1998; Riskin, 1994). Second, some counties in the middle-income group are also designated as poor, which causes great resource leakage to the non-poor regions (Wang, 2004). Third, targeting funds for poverty alleviation purpose has not been well-distributed to these designated poor areas (Park, et al., 2002; World Bank, 2001). A survey in 1994 indicated that 30% of the poverty alleviation funding and the food for work funding from the central government, intentionally targeted to the 592 key poor counties, were directed to other places. Only 70% of the poverty alleviation funds and the food for work

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<sup>2</sup> The poverty line is 668 Yuan and the low-income line is 924 Yuan in 2004.

program and 60% of the funding to support underdeveloped areas reached the designated poor counties in 1994 (Pan, et al., 1995). Fourth, all the poverty alleviation funds from the government target the defined regions and projects instead of the poor populations.

In order to target the poverty population more efficiently, China began to adjust its poverty targeting unit from the county level to the village level. In 2001 the Chinese government designated 148,051 poverty villages in total, 21.4% of all administrative villages. The central and western regions account for 88.4% of these designated poverty villages. The originally designated poverty counties account for 55.6% of the newly designated poverty villages.

#### *China's poverty alleviation programs*

The Chinese government has made a strong commitment to poverty alleviation and implemented many poverty alleviation programs. As Zhang et al. (2002) pointed out, before the economic reform in the late 1970s, the Chinese central government was already heavily subsidizing through large direct budget transfers (Park, et al., 1996) and grain sold at preferential prices to farmers in poor regions (Park, et al., 2002). Since 1986, China launched a large-scale poverty alleviation program which included three main targeted poverty investment programs: a subsidized loan program administered by the Leading Group's PADO and the Agricultural Development Bank, a Food-for-Work program run by the State Planning Commission, and a development fund program managed by the Ministry of Finance.

The subsidized credit and loan plan for poor people is the largest poverty alleviation program in China. Since the beginning of this plan in 1986, the Chinese government has allocated about 68 billion Yuan of subsidized loans that are only allowed to be used in selected



“key poverty counties”. However, most of these poverty loans are misused to subsidize unproductive township enterprises and households with the ability to repay the loan. Only a small part of these subsidized loans reached the hands of poor people in need. As shown in Figure 3.4, only 16 percent of small loans reached targeted farmers in 2002. Infrastructure projects and agricultural industrialization projects account for a large share of the subsidized loans, 22 percent and 32 percent, respectively.

The Food-for-Work program started in 1984 was aimed at improving the infrastructure conditions in poor regions. Before 1995, through this program, rural labor worked on road and irrigation projects during the off-farming season and the central government subsidized the workers through its overstocked grain, cotton, clothes, and other commodities. Since 1996, the central government budget took over this program and began to pay money rather than commodities to the workers. Until 2002, the Chinese government used 45.9 billion Yuan (including commodities paid before 1995 worth 16.9 billion Yuan) in the Food-for-Work program (Rural Survey Organization of National Bureau of Statistics, 2003).

In 2002, the Food-for-Work program helped construct three million  $mu^3$  in basic farmland, improved seven million  $mu$  of farmland irrigated area, solved the drinking water problems for four million people and more than three million livestock, constructed 38,000 kilometers of road in counties and villages, tackled the problems of water and soil erosion on 6.8 million  $mu$  of land, and constructed more than five million  $mu$  of grassland. Basically, the

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<sup>3</sup>  $Mu$  is a Chinese unit of area. One  $mu$  equals to one fifteenth of a hectare.

Food-for-Work program helped the development of poor regions and increased the farmers' income.

Through the development fund program, the Ministry of Finance in China provides earmarked budgetary grants to local governments to fund a wide range of public investment projects in poor regions. The development fund program consists of four categories, among which two are coordinated by the national Leading Group for Economic Development in Poor Areas (LGEDPA) as poverty investments. These two categories include the Development Fund for Assisting Undeveloped Areas, which began in 1980, and the Three-West Fund, starting in 1983. Through the former program, the Chinese government allocates 800 million Yuan each year to poor regions focusing on the old revolutionary base and autonomous counties of minority nationalities. Through the Three-West Fund program, the Chinese government allocates 200 million Yuan each year to 47 counties in three northwest prefectures. Investments through these two programs did not increase significantly through the later 1980s and early 1990s, but they have increased dramatically since 1997 and even reached the funding level of the Food-for-Work program in the 2000s (Wang, 2002).

### **3.2. China's Foreign Trade and Poverty Reduction**

China's economic center has changed over time. In early Chinese history, the southeast coastal region was uncultivated and sparsely populated. The Loess Plateau, the Yellow River Valley and Northwest, which are today's poor regions, used to be China's economic center. The historically famous Silk Route channeled China's international trade through the northwest

corner of China. Over time, the southeast China became densely populated. After the Opium War in 1840, China was forced to open up several ports and further the whole country for trade. The coastal region began to play an increasingly important role as China's economy was transformed through international trade and foreign direct investments.

In 1949 the Communist Party of China under the leadership of Chairman Mao established a new government. During the first thirty years, China adopted a centrally planned economic system which favored heavy industries, and minimized trade and financial linkages with capitalist economies. Large projects invested by the government were mainly located in the northeast and other inland provinces, which were suffering from slow growth and outdated techniques. East China did not receive preferential policy supports.

Before China's economic reforms and open door policy, China was an insignificant player in international trade. The Ministry of Foreign Trade fully controlled China's foreign trade and product-specific national foreign trade corporations (FTCs) conducted trade under a near total mandatory trade plan. In 1977, China's total trade volume was only \$14.8 billion, accounting for 0.6% of world trade (Fung, et al., 2002). Since 1979, China introduced a series of measures to reform its import and export systems and gradually rose to international importance in world trade. The share of China's foreign merchandise trade in the total world trade exceeded 2% in 1992 and kept on growing to almost 7% in 2005. Both China's merchandise exports and imports increased at the same time, indicating that China has become a very important competitor and/or market to many countries in international markets.

China has made great effort to integrate itself into the world economy over the past two

and a half decades. After 15 years of negotiations, China officially joined the World Trade Organization (WTO) on December 11, 2001 and became its 143<sup>rd</sup> member. Due to the size and potential of the Chinese economy, China's accession to the WTO has significant impacts on its trade partners and the rest of the world. By accepting the rules and regulations of the WTO, China committed itself to open its market further and to level most of its trade and investment barriers within two to five years. China promised to cut its overall tariff level from 15.6% in 2000 to 10% in 2008, the average tariff on industrial products from 14.7% in 2000 to 9.2% in 2008 and the tariffs on agricultural products from 21.3% in 2000 to 15.1% in 2008 (Table 3.4). In practice, the tariff levels have been lowered more than the negotiated amounts. China's market distortions have been reduced significantly over the past two and a half decades (Huang, et al., 2005). In addition to tariff cuts, China also promised to allow foreign capital to gradually enter some industries, such as heavy industries, agriculture, finance and retail, which are still under protection.

As a result of China's accession to the WTO, China will greatly boost its trade growth in the future. This trend actually is confirmed by the available data over the years after China's WTO accession. The trade growth rate after China's WTO accession is much higher than that before its accession (Table 3.5). China's trade grew at an annual rate of 11.7% in the 1980s, 15.2% in the 1990s and 24.6% in 2000 to 2005. How will China's international trade growth help reduce the poverty in China? If China's trade liberalization over the past two and a half decades was the driving force to contribute to China's poverty reduction, we can definitely be very optimistic about China's poverty reduction in the future.

The World Bank argued that significant liberalization of China's trade regime is a key element in reducing poverty in China. A closer look at China's foreign trade may help us to understand whether such a relationship between trade liberalization and poverty reduction is true in China. There was a dramatic decline in China's poverty incidence in the early 1980s, the first stage of China's poverty alleviation. However, this largely preceded the country's external trade reforms. Foreign trade did not increase much during the period of large poverty incidence decline. China's poverty reduction pace came down during the second stage of China's poverty alleviation (late 1980s), while China's foreign trade kept on growing. In the beginning of the twenty-first century, China faces a big challenge to further reduce its poverty population significantly. In fact, China's poverty population even increased 0.8 million for the first time in 2003. This took place at the same time that China's foreign trade was increasing at an annual rate of 24.6%. China's poverty alleviation doesn't seem to keep pace with China's foreign trade growth.

China's regional trade pattern also shed some light on this relationship between China's poverty alleviation and foreign trade. Table 3.6 shows China's regional trade pattern in 2004. Four provinces (Shanghai, Jiangsu, Zhejiang and Guangdong) accounted for 68.8% of China's total foreign trade and 69.3% of China's total exports in 2004. Guangdong province alone accounted for 31.5% of China's total foreign trade and 32.4% of China's total exports. These four provinces already had a very low poverty incidence in the early 1980s. It is a similar situation for other important trade provinces where trade is growing and the poverty levels are low. Thus, even though China's foreign trade has increased dramatically over the past two

decades, the poverty intensity of trade (trade with poor countries and inland regions) has been very low. China's regional trade pattern indicates that China's trade liberalization is not a key element in contributing to its poverty reduction.

#### *Remittance on poverty*

Since the mid-1990s, a large number of farmer workers began to go to cities to work. In 2001, the number of outgoing rural workers (who work outside their own town and village) in China was 78 million, accounting for 16.3% of China's total rural workers. This unprecedented mobilization of farmer workers in China reached its peak at the end of 1990s. In recent years, the number of outgoing rural workers has remained high, but the rate of increase has come down. The majority of those outgoing rural workers come from the central and western regions which are generally poor and 80% of inter-province labor mobilization flowed into the Eastern coastal regions.

The interregional labor mobilization from the central and western regions to coastal regions provides more job opportunities to the rural surplus labor, which helps to increase their income to some extent. However, the income of those outgoing rural workers generally was not high. According to a survey in 2001, the average monthly income was 583 Yuan and 83.6% of them had an income range between 200-800 Yuan (Ge, 2004). In terms of the annual income, 57.1% of them had an annual income below 5000 Yuan and the averaged annual income was 5532 Yuan.

With the low average income, many of the rural workers in cities actually are another poverty group in urban areas in addition to regular urban poverty. However, these rural workers

in cities send a huge amount of remittances to their hometowns in central and Midwestern regions. In 2001, outgoing rural workers sent remittances in cash to Sichuan, Chongqin, Anhui, Hunan, Jiangxi and Guizhou amounting to 23.5 billion Yuan, 12 billion Yuan, 15.9 billion Yuan, 12.3 billion Yuan and 3.4 billion Yuan, respectively. Remittances from outgoing rural workers in many provinces have outpaced their local fiscal income (Ge, 2004). Remittance in these regions play a very important role in poverty alleviation.

Foreign trade increases in coastal regions may provoke the direct or derived demand for outgoing rural workers to these regions. Thus, one may conclude that foreign trade contributed to China's poverty alleviation over the past two decades through remittance channels. However, one must notice that the large scale of mobilization of outgoing rural workers into cities started only after the mid-1990s, which is the third stage of China's rural poverty reduction. Remittances may have played an important role in alleviating the rural poverty since the mid-1990s. However, it certainly did not contribute much to poverty reduction in the first and the second stage of China's poverty alleviation history.

In summary, China's tremendous achievement in poverty alleviation is attributed to agricultural productivity growth roused from economic reform, varieties of poverty alleviation programs and the large scale of remittances coming from outgoing rural workers in cities. As China integrates itself into the world economy, China's international trade has risen to a more important role in the international economy and it contributes to economic development in the coastal regions. However, China's increased international trade is not found to contribute significantly to poverty alleviation in China, especially in poor inland and remote regions. As

China's international trade increases further, positive impacts of international trade may spill over to the poor inland and remote regions if marketing conditions and other institutional environments improve significantly. Thus, it becomes an open question about how trade liberalization will affect China's poverty alleviation in the future.



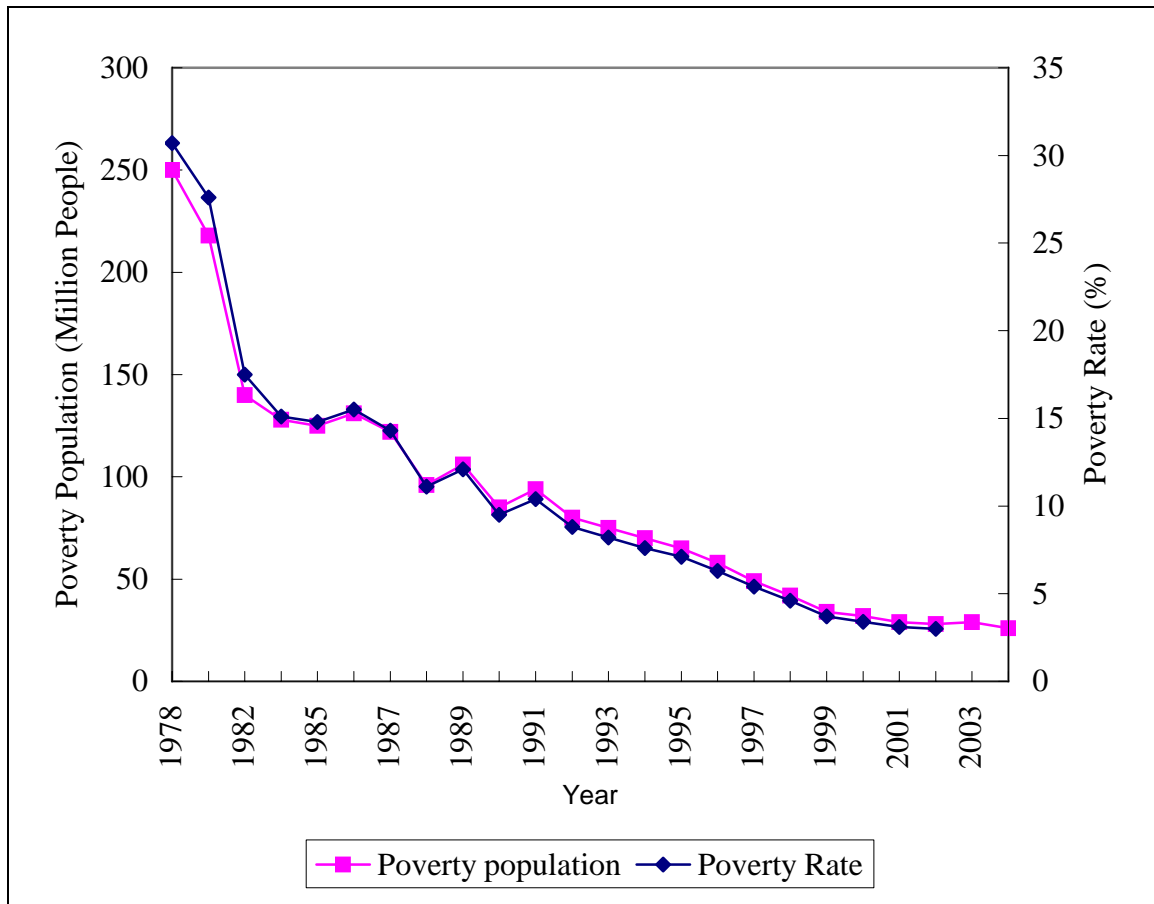


Figure 3.1: China's Official Poverty line and rural poverty headcounts (1978-2002)

Source: Wang (2004) and National Bureau of Statistics (2000-2004).

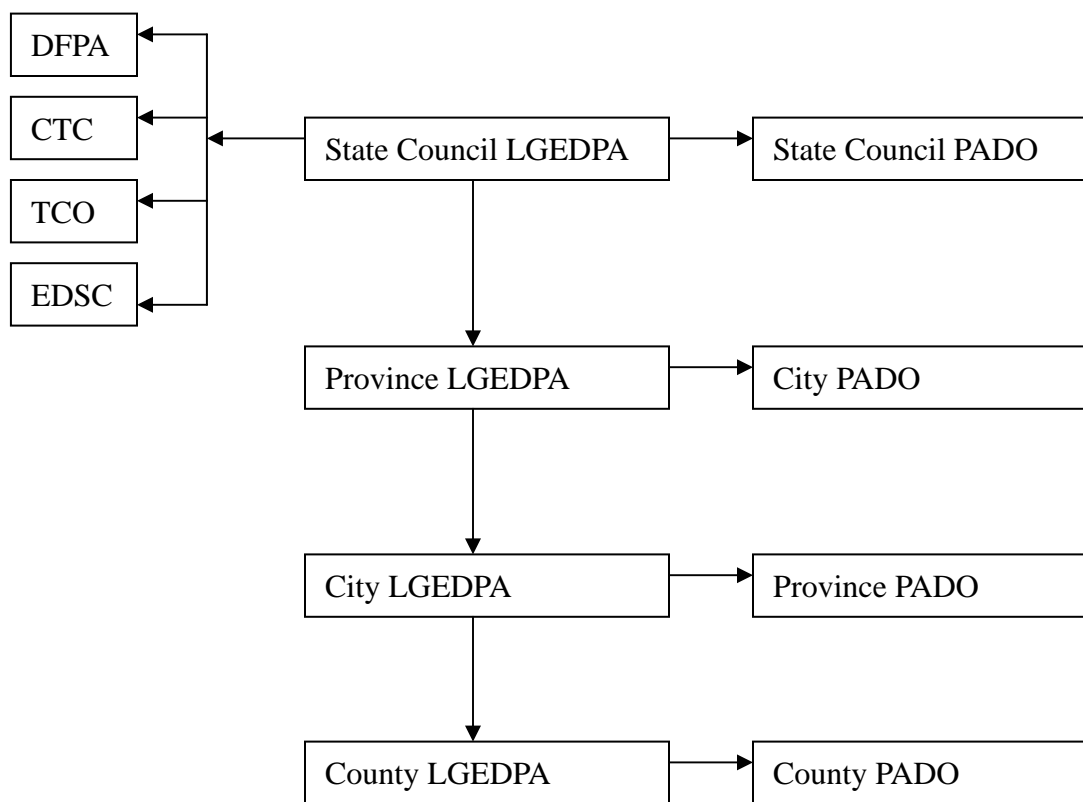


Figure 3.2: Official Institutional Structure of China's Poverty Alleviation

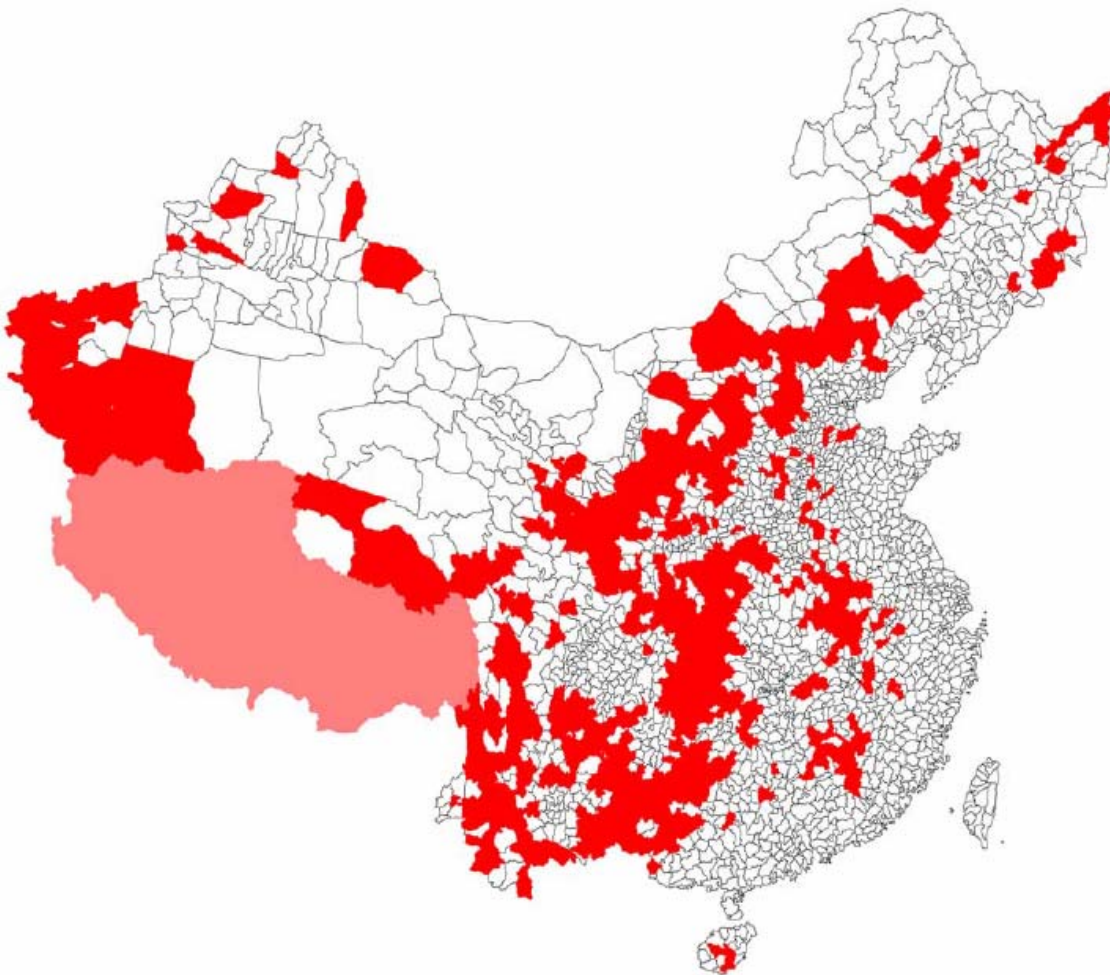


Figure 3.3: Key Counties in National Poverty Alleviation Program in 2001.  
Source: Heilig, et al., 2005

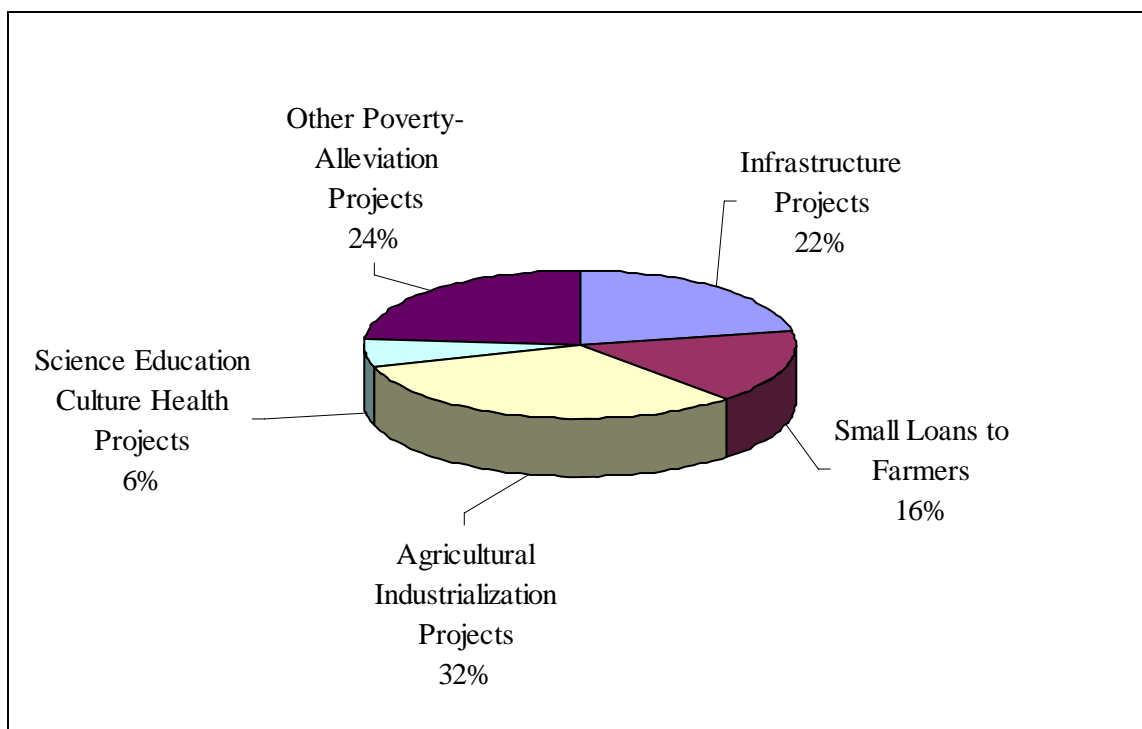


Figure 3.4: Allocation of Subsidized Credits and loans for poverty alleviation plan in China in 2002.

Source: Rural Survey Organization of National Bureau of Statistics (2003)

Table 3.1: Poverty Incidence by Province (1985, 1993, and 2001)

Province	Poverty Incidence			% of national poor population		
	1985	1993	2001	1985	1993	2001
North						
Beijing	0.0	0.55	0.53	0	0.03	0.06
Tianjin	0.0	0.14	0.52	0	0.01	0.07
Hebei	4.90	13.76	1.81	1.88	9.07	3.33
Henan	24.90	12.59	2.1	13.68	11.92	5.64
Shandong	2.30	5.83	0.7	1.24	5.18	1.56
Northeast						
Liaoning	6.5	3.85	3.22	1.14	1.07	2.55
Jilin	0.0	6.23	3.08	na	1.13	1.51
Heilongjiang	14.1	5.22	4.55	2.08	1.2	2.92
Northwest						
Inner Mongolia	10.6	10.75	13.3	1.17	1.9	6.28
Shanxi	4.1	11.87	6.62	0.69	3.31	5.25
Shaanxi	41.6	19.19	7.78	8.33	6.5	7.36
Ningxia	53	29.53	13.6	1.34	1.31	1.8
Gansu	43.9	26.15	9.6	6.03	6.2	6.64
Qinghai	5	16.79	16.9	0.11	0.66	1.95
Xinjiang	0.9	14.1	6.5	0.05	1.48	2.02
Yangze River						
Shanghai	0	0.15	0	0	0.01	0
Jiangsu	0	2.42	0.2	na	1.61	0.36
Zhejiang	4.5	3.53	0.18	1.22	1.57	0.23
Anhui	5.1	8.55	1.79	1.83	5.19	3.13
Jiangxi	12.1	3.24	2.76	2.72	1.27	3.02
Hubei	3.7	6.16	1.82	1.16	3.12	2.44
Hunan	12.6	3.14	2.09	4.92	2.06	3.86
South						
Fujian	6.3	1.14	0.24	1.16	0.37	0.22
Guangdong	0	0.5	0.06	Na	0.34	0.14
Hainan	Na	4.67	1.72	Na	0.27	0.3

Table 3.1: (Continued)

Province	Poverty Incidence			% of national poor population		
	1985	1993	2001	1985	1993	2001
Southwest						
Guangxi	22.2	7.82	3.35	6.08	3.72	4.62
Chongqing	Na	Na	3.99	Na	Na	3.33
Sichuan	35.1	10.12	3.31	24.98	11.77	7.83
Guizhou	36.8	21.85	10.4	7.72	7.9	11.12
Yunnan	41.3	23.77	7.89	9.9	9.71	9.34
Tibet	Na	5.98	15.2	Na	0.15	1.13
National Average	14.81	8.83	3.20	100	100	100

Source: Wang (2004).

Table 3.2: Selected Indicators at County-level in 2001.

	Non-Poverty Counties	Poverty Counties
<b>Indicators</b>		
<b>Economy</b>		
GDP (yuan per capita)	5,050.10	2,689.50
GDP of primary industry (yuan per capita)	1,390.40	1,084.20
GDP of secondary industry (yuan per capita)	2,038.30	782.4
Employment in tertiary sector (in % of all employed)	19.8	11.1
Employment in secondary sector (in % of all employed)	15.8	4.9
Government expenditures (yuan per capita)	385.2	452.4
Non-agricultural population (in % of total population)	24.3	11.7
<b>Education</b>		
Student enrollment of secondary schools (in % of total population)	5.1	4.7
Student enrollment of primary schools (in % of total population)	8.9	12.3
Illiterate population (in % of total population age 15+)	9.6	20.7
Population with no school (in % of population age 6+)	7.5	16.4
Population with college degree (in % of population age 6+)	0.75	0.19
Average years at school	7.5	6
<b>Demography</b>		
Total population (in million) /1	1,057	211
Population density (persons per km <sup>2</sup> )	787.6	144.6
Ethnic Minority population (in % of total population)	10.7	39.3
Rural population (in % of total population)	65.7	85.3
Birth rate (birth per 1000 of the population)	11.6	15.6
Natural growth rate (per 1000 of the population)	5.7	8.6
Death rate (per 1000 of the population)	5.9	7.0
Total fertility rate (TFR) (from 9.5% sample survey)	1.27	1.71
<b>Infrastructure</b>		
Road length (m per km <sup>2</sup> of land area)	99	68
Hospital beds (per county)	737	451
Hospital beds (per 10,000 of the population)	17.5	16.6
Hospital beds (per km <sup>2</sup> of land area)	0.71	0.2
Households with telephone (in % of all households)	28.4	16.5
Households without tap water (in % of all households)	5.3	7.4

Table 3.2: (continued)

Households with bath facility (in % of all households)	2.3	0.8
Households with WC (in % of all households)	6.6	5.9
<b>Agriculture</b>		
Cultivated land (in % of total land area)	40.1	20.7
Per capita cultivated land (hectare per person)	0.201	0.195
Average grain yield (kg per hectare)	4,896	3,399
<b>Physical Characteristics (climate, topography)</b>		
Slope above 8 degree %	36.1	72.2
Slope above 15 degree %	29.2	60.3
Slope above 30 degree %	14.6	29.3
Average altitude (in meters)	566	1,633
Average precipitation (in mm per year)	972	825
Accumulated temperature (>10 degree celsius per year)	4,356	3,217
Average temperature of warmest month in the area (degree celsius)	29	25
Average temperature of coldest month in the area (degree celsius)	-7	-10

Source: Heilig, et al., 2005



Table 3.3: National Government's Investment in China's Poor Areas by Program  
(billion Yuan), 1986-97.

	Total Poverty Investment		Development Fund		Subsidized credit		Food for Work	
Year	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real
1986	4.1	3.9	1.0	0.9	2.3	2.2	0.8	0.7
1987	4.1	3.7	1.0	0.9	2.3	2.1	0.8	0.7
1988	4.1	3.1	1.0	0.8	2.9	2.2	0.2	0.2
1989	4.2	2.7	1.0	0.6	3.0	1.9	0.2	0.1
1990	2.7	2.8	1.0	0.6	3.0	1.8	0.7	0.4
1991	8.3	4.9	1.0	0.6	3.5	2.1	3.8	2.3
1992	6.7	4.9	1.0	0.6	4.1	2.3	3.6	2.0
1993	8.7	4.8	1.1	0.5	3.5	1.7	5.1	2.5
1994	11.7	4.7	1.1	0.4	4.5	1.8	6.1	2.5
1995	11.8	3.0	0.9	0.3	4.8	1.7	6.1	1.1
1996	10.1	3.2	1.3	0.4	5.7	1.8	3.1	1.0
1997	14.6	4.5	2.8	0.9	8.7	2.8	3.1	1.0
Total	93.1	46.2	14.2	7.5	48.3	24.4	33.6	14.5

Source: Zhang, et al., 2002

Table 3.4: China's Promise on Tariff Reduction

Year	Overall Tariff Level	Averaged tariff of Industrial Products	Averaged tariff of Agricultural Products
2000	15.6%	14.7%	21.3%
2001	14.0%	13.0%	19.9%
2002	12.7%	11.7%	18.5%
2003	11.5%	10.6%	17.4%
2004	10.6%	9.8%	15.8%
2005	10.1%	9.3%	15.5%
2006	10.1%	9.3%	15.5%
2007	10.1%	9.3%	15.5%
2008	10.0%	9.2%	15.1%

Source: People Daily Official website. Available at

<http://www.people.com.cn/GB/jinji/31/179/20020114/647339.html>

Table 3.5: China's Foreign Merchandise Trade in 1976-2005  
(US\$ billion at current prices)

Year	World			China			%
	Exports	Imports	total	Exports	Imports	total	
1976	992	1026	2018	6.94	6.66	13.60	0.67%
1977	1128	1171	2299	7.52	7.15	14.67	0.64%
1978	1307	1358	2665	9.96	11.13	21.09	0.79%
1979	1659	1694	3353	13.61	15.62	29.24	0.87%
1980	2034	2075	4109	18.10	19.94	38.04	0.93%
1981	2010	2066	4076	22.01	22.01	44.02	1.08%
1982	1883	1941	3824	22.32	19.29	41.61	1.09%
1983	1846	1890	3736	22.23	21.39	43.62	1.17%
1984	1956	2014	3970	26.14	27.41	53.55	1.35%
1985	1954	2015	3969	27.35	42.25	69.60	1.75%
1986	2138	2206	4344	30.94	42.90	73.85	1.70%
1987	2516	2582	5098	39.44	43.22	82.65	1.62%
1988	2869	2963	5832	47.52	55.27	102.78	1.76%
1989	3098	3201	6299	52.54	59.14	111.68	1.77%
1990	3449	3550	6999	62.09	53.35	115.44	1.65%
1991	3515	3633	7148	71.91	63.79	135.70	1.90%
1992	3766	3882	7648	84.94	80.59	165.53	2.16%
1993	3781	3876	7657	91.74	103.96	195.70	2.56%
1994	4325	4428	8753	121.01	115.62	236.62	2.70%
1995	5162	5282	10444	148.78	132.08	280.86	2.69%
1996	5401	5545	10946	151.05	138.83	289.88	2.65%
1997	5589	5740	11329	182.79	142.37	325.16	2.87%
1998	5499	5681	11180	183.71	140.24	323.95	2.90%
1999	5713	5919	11632	194.93	165.70	360.63	3.10%
2000	6451	6724	13175	249.20	225.09	474.30	3.60%
2001	6184	6482	12666	266.10	243.55	509.65	4.02%
2002	6484	6734	13218	325.60	295.17	620.77	4.70%
2003	7572	7855	15427	438.23	412.76	850.99	5.52%
2004	9191	9545	18736	593.33	561.23	1154.56	6.16%
2005	10393	10753	21146	762.00	660.12	1422.12	6.73%

Note: The figures are in US\$ billion. Exports are valued on a f.o.b. basis, imports on a c.i.f. basis.

Source: WTO International Trade Statistics (<http://stat.wto.org>)

Table 3.6: Regional Trade, export and import value in 2004.

	Total Trade			Exports			Imports		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
National	1154.6	1154.6	663.2	593.3	593.3	338.6	561.2	561.2	324.6
<b>North</b>									
Beijing	42.820	94.576	18.527	13.117	20.569	7.362	29.703	74.087	11.165
Tianjin	43.236	42.029	34.088	20.479	20.852	17.052	22.758	21.180	17.037
Hebei	15.280	13.526	4.260	9.710	9.339	2.657	5.570	4.186	1.603
Henan	7.355	6.620	1.221	4.400	4.175	0.704	2.955	2.445	0.516
Shandong	69.416	60.658	32.226	37.178	35.845	18.397	32.237	24.821	13.829
<b>Northeast</b>									
Liaoning	39.934	34.411	20.665	19.586	18.914	10.898	20.348	15.519	9.768
Jilin	7.487	6.790	3.521	1.917	1.715	0.505	5.570	5.078	3.015
Heilongjiang	7.183	6.789	0.763	3.720	3.681	0.381	3.463	3.110	0.382
<b>Northwest</b>									
Inner Mongolia	4.375	3.722	0.272	1.887	1.354	0.155	2.488	2.367	0.116
Shaanxi	4.557	3.642	0.658	2.624	2.397	0.227	1.933	1.246	0.431
Shanxi	9.069	5.382	0.685	7.196	4.034	0.518	1.873	1.347	0.168
Ningxia	1.131	0.908	0.135	0.735	0.646	0.091	0.396	0.262	0.044
Gansu	1.964	1.763	0.167	1.036	0.996	0.126	0.928	0.777	0.041
Qinghai	0.648	0.576	0.010	0.462	0.455	0.004	0.186	0.121	0.005
Xinjiang	6.023	5.635	0.178	2.921	3.046	0.110	3.101	2.589	0.067
<b>Yangze River</b>									
Shanghai	156.799	160.010	107.232	69.731	73.505	49.488	87.068	86.512	57.743
Jiangsu	179.542	170.849	135.538	88.039	87.494	65.152	91.502	83.360	70.387
Zhejiang	94.659	85.205	32.626	61.153	58.139	19.651	33.507	27.070	12.975
Anhui	6.991	7.212	1.962	3.559	3.937	0.965	3.432	3.275	0.997
Jiangxi	4.818	3.528	1.156	2.608	1.995	0.529	2.210	1.534	0.627
Hubei	7.559	6.766	2.345	3.252	3.382	0.985	4.307	3.389	1.360
Hunan	6.082	5.444	1.069	3.144	3.106	0.503	2.938	2.337	0.566
<b>South</b>									
Fujian	49.847	47.527	31.166	30.551	29.395	18.419	19.297	18.153	12.748
Guangdong	363.354	357.131	226.530	192.411	191.571	121.711	170.943	165.575	104.820
Hainan	2.900	3.402	1.430	0.825	1.093	0.350	2.075	2.309	1.080
<b>South West</b>									
Guangxi	4.832	4.277	1.469	2.314	2.386	0.496	2.518	1.892	0.973
Chongqin	3.730	3.857	1.265	1.876	2.091	0.219	1.854	1.766	1.047
Sichuan	6.694	6.867	1.303	3.488	3.980	0.552	3.206	2.888	0.751
Guizhou	2.370	1.514	0.388	1.268	0.867	0.189	1.102	0.647	0.199

Table 3.6: Regional Trade, export and import value in 2004 (continued).

	Total Trade			Exports			Imports		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Yunnan	3.734	3.741	0.316	2.020	2.239	0.210	1.714	1.512	0.107
Tibet	0.165	0.200	0.004	0.119	0.130	0.002	0.047	0.070	0.003

Source: China's Economic Information Website Online database (<http://db.cei.gov.cn>)

Note: (1) indicates that calculation is based on commodities' origin or destination;

(2) indicates that calculation is based on firms' location;

(3) indicates the transaction conducted by foreign firms.

## CHAPTER FOUR

### NEW CLASSICAL TRADE-POVERTY MODEL

This chapter applies a new classical economic framework developed by Cheng et al. (2000) into trade-poverty analysis. We modify their 2X2 new classical general equilibrium model by assuming that two countries have different transaction efficiencies. From the perspective of division of labor, we examine how trade liberalization will affect the welfare of the poor developing country through comparative static analysis.

#### 4.1. New Classical General Equilibrium Trade Model: Free Trade

##### 4.1.1. New Classical 2x2 Ricardian Model Under Free Trade

Consider a developed country and a developing country, each with  $M_i$  ( $i = 1, 2$ ) consumer-producers. Both countries consume only two goods  $x$  and  $y$  where we assume good  $x$  is capital-intensive and good  $y$  is labor-intensive. The rich developed country is assumed to have absolute advantage in producing both goods  $x$  and  $y$  over the poor developing country, while the poor developing country has exogenous comparative advantage in producing good  $y$ . Within each country, all consumer-producers are assumed to be *ex ante* identical<sup>1</sup>. Each consumer-producer has the following utility function.

$$u_i = (x_i + k_i x_i^d)^\beta (y_i + k_i y_i^d)^{(1-\beta)} \quad (4.1a)$$

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<sup>1</sup> The assumption of *ex ante* identical consumer-producers seems very strong, since there doesn't exist two identical persons in the real world. However, as Adam Smith indicated, many differences between specialists are *ex post* differences due to different occupation choices (Yang, 2001).

where  $x_i$  and  $y_i$  are respective amounts of good  $x$  and  $y$  produced for self-consumption,  $x_i^d$  and  $y_i^d$  are respective amounts of the two goods purchased from the market in country  $i$ ,  $(1-k_i)$  is the iceberg transaction cost coefficient, and  $k_i$  is the exogenous trading efficiency coefficient which represents the regional conditions governing transactions.  $k_i$  is determined by infrastructure conditions, degree of urbanization, transportation conditions, communication conditions, general institutional environment and other factors. Although the transaction cost coefficient for each transaction is exogenous, the total transaction cost for each consumer-producer, and thus for society, is endogenous since the number of transactions is endogenized in our model<sup>2</sup>. The rich developed country is assumed to have higher trading efficiency than the poor inland region, implying  $k_1 > k_2$ . For simplicity, we also assume a taste preference coefficient  $\beta = 0.5$ .

Each consumer-producer's production function and endowment constraint are as follows

$$x_i + x_i^s = \alpha_{ix} l_{ix}, \quad y_i + y_i^s = \alpha_{iy} l_{iy}, \quad (\text{production function}) \quad (4.1b)$$

$$l_{ix} + l_{iy} = l \quad (\text{labor constraint}) \quad (4.1c)$$

where  $x_i^s$  and  $y_i^s$  are respective amounts of the two goods that an individual in country  $i$  ( $i=1, 2$ ) sells to the market;  $\alpha_{ix}$  and  $\alpha_{iy}$  represent the individual's labor productivity in producing goods  $x$  and  $y$  in country  $i$ , individuals in the developed country are assumed to have absolute advantages in producing both products, thus, we have  $\alpha_{1x} > \alpha_{2x}$  and  $\alpha_{1y} > \alpha_{2y}$ ;  $l_{ix}$  and  $l_{iy}$  denote the amount of labor allocated to the production of good  $x$  and  $y$ , and individuals in both regions are

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<sup>2</sup> A general definition of endogenous transaction cost is taken here that all transaction costs are endogenous if their levels can be seen only after individuals have made their decisions (Yang, 2001).

assumed to have the same amount of labor endowment ( $l$ ) to allocate in their production.

Each individual faces a budget constraint as

$$p_x x^s + p_y y^s = p_x x^d + p_y y^d \quad (4.1d)$$

where  $p_j$  is the price of good  $j$  ( $j = x, y$ ). Hence, the left-hand side of (4.1d) is income from market sales and the right-hand side is expenditure. Allowing for corner solutions, we have the nonnegativity constraint as

$$x, x^s, x^d, y, y^s, y^d, l_x, l_y \geq 0 \quad (4.1e)$$

Under the above constraints, an individual makes decisions on what and how much to produce for self-consumption, and how much to sell to and to buy from the market. In other words, the individual chooses six nonnegative variables  $x, x^s, x^d, y, y^s, y^d$ . Hence, there are  $2^6 = 64$  possible corner and interior solutions<sup>3</sup>. For such a model, Wen showed that an individual will never simultaneously sell and buy the same good, never simultaneously produce and buy the same good, and never sell more than one good (Wen, 1998). This is called as Wen's theorem. New classical economics denotes each individual's choice of what to produce, to buy and to sell being consistent with Wen's theorem as a *configuration*. Thus, the individuals can choose only from three possible configurations:

#### *Configuration of autarky (A)*

For configuration (A), an individual in region  $i$  is in autarky where he/she produces both goods  $x$  and  $y$  only for self-consumption. He/she does not sell any product to the market in

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<sup>3</sup> Because we assume different transaction cost coefficients for the two countries, the individual needs to decide the supply and demand level in each regional market. However, this will not increase the number of solutions.

exchange for another good for own consumption purpose. In another word, this individual's own production of both goods are nonnegative but his/her market demand and supply of both goods are zero. Thus, this configuration can be defined by  $x_i, y_i, l_{ix}, l_{iy} > 0$ ,  $x_i^d = x_i^s = y_i^d = y_i^s = 0$  and  $i = 1, 2$ .

*Configuration (P): partial specialization in the comparative advantaged good.*

An individual in the rich developed country ( $i = 1$ ) partially specializes in producing its comparative advantaged good  $x$ , which can be denoted as  $(xy/y)_1$  where he/she produces both goods  $x$  and  $y$  and sells good  $x$  and purchases good  $y$  from the developing country. This can be defined by  $x_1, y_1, x_1^s, y_1^d > 0$ ,  $x_1^d = y_1^s = 0$ . An individual in the poor developing country ( $i = 2$ ) specializes in producing its comparative advantaged good  $y$ , which can be denoted as  $(xy/x)_2$  where he/she produces both goods  $x$  and  $y$  and sells good  $y$  and purchases good  $x$  from the developed country. This can be defined by  $x_2, y_2, x_2^d, y_2^s > 0$ ,  $x_2^s = y_2^d = 0$ .

*Configuration (C): complete specialization in the comparative advantaged good.*

An individual in the rich developed country completely specialize in producing its comparative advantaged good  $x$ , which can be denoted as  $(x/y)_1$ . This individual sells good  $x$  of his/her own production for good  $y$  from the developing country. This configuration can be defined by  $x_1, x_1^s, y_1^d > 0$ ,  $y_1 = x_1^d = y_1^s = 0$ . The poor developing country completely specializes in producing its comparative advantaged good  $y$ , which can be denoted as  $(y/x)_2$ . This individual sells good  $y$  of his/her own production for good  $x$  from the developed country. This configuration can be defined by  $y_2, x_2^d, y_2^s > 0$ ,  $x_2 = x_2^s = y_2^d = 0$ .

Each individual in both countries has freedom to choose any one of the above three types



of configurations and combinations of their configuration choices constitute a *market structure*.

Consider there is a representative consumer-producer in each country and their configuration choice combinations constitute four possible market structures illustrated in Figure 4.1.

For structure AA, all individuals in each country choose the configuration of autarky. For structure PC, the representative individual in the developed country chooses configuration P where he/she partially specializes in producing good  $x$  and the representative individual in the developing country chooses configuration C where he/she completely specializes in producing good  $y$ . For structure CP, the representative individual in the developed country chooses configuration C where he/she completely specializes in producing good  $x$  and the representative individual in the developing country chooses configuration P where he/she partially specializes in producing good  $y$ . For structure CC, all individuals in each country choose configuration C where he/she completely specializes in their comparative advantaged good.

The general equilibrium of the world economy is defined as a resource allocation and trade network structure satisfying the following conditions:

- (a) Each individual maximizes his/her utility through choosing the consumption bundle generated by his/her production and trade decisions at a given set of prices with respect to configurations.
- (b) All markets clear.

The individuals make their utility maximization decisions based on inframarginal analysis. That is, the individuals first choose the configuration of specialization and then make decisions on resource allocation for the chosen configuration of specialization and the constituent

market structure.

In the neoclassical economics framework, interior optimum solutions are common and corner solutions are exceptional because of the dichotomy of pure consumers and firms. However, in the new classical economics framework, the interior solutions never take place in equilibrium (Yang, 2001). Thus, we cannot use standard marginal analytical methods in neoclassical economics to solve for a general equilibrium because of the existence of these corner solutions.

Yang (2001) proposed a two step approach to solve for a general equilibrium in such a model. In the first step, we can solve for the corner equilibrium which consists of supply and demand functions of each good and the corresponding relative market price for a given market structure. There is one corner equilibrium for each one of four possible market structures. In the second step, we plug the corner equilibrium relative market price into the indirect utility function for each constituent configuration in a given structure and then compare corner equilibrium utility values across those configurations and the configurations in other structures. The comparisons across configurations in all specified structures are called total cost-benefit analysis which defines the conditions under which the corner equilibrium utility in each constituent configuration for a given market structure is a global maximum. This corner equilibrium is thus a general equilibrium within this parameter subspace. Therefore, we partition the parameter space into several parameter subspaces and identify the general equilibrium with each partitioned subspace.

#### 4.1.2. Solutions for the General Equilibrium

4.1.2a. First step: Solutions for the corner equilibrium with respect to a given market structure.

Structure AA

Individuals in both countries choose autarky configuration and their decision problems can be written as:

$$\underset{x_i, x_i^s, y_i, y_i^d, l_{ix}, l_{iy}}{\text{Max}}: U_i = x_i^{0.5} \cdot y_i^{0.5} \quad (4.2a)$$

$$\text{s. t. } x_i = \alpha_{ix} l_{ix}, \quad y_i = \alpha_{iy} l_{iy} \quad (4.2b)$$

$$x_i^s = x_i^d = y_i^s = y_i^d = 0 \quad (4.2c)$$

$$l_{ix} + l_{iy} = l \quad (4.2d)$$

Substituting (4.2c) and (4.2d) into (4.2a), we have the unconstrained utility maximization problems:

$$\underset{l_{ix}}{\text{Max}} U_i = (\alpha_{ix} l_{ix})^{0.5} \cdot (\alpha_{iy} (l - l_{ix}))^{0.5} \quad (4.2e)$$

The first order condition with respect to  $l_{ix}$  of equation (4.2e) is

$$\frac{dU_i}{dl_{ix}} = \frac{\alpha_{ix} \alpha_{iy} (l - 2l_{ix})}{2(\alpha_{ix} l_{ix})^{0.5} \cdot (\alpha_{iy} (l - l_{ix}))^{0.5}} = 0 \quad (4.2f)$$

Hence, we can have optimum amount of labor allocated to production of good  $x$  as

$$l_{ix} = \frac{1}{2} l \quad (4.2g)$$

Substituting equation (4.2g) back into equation (4.2b), we have the production functions of both goods  $x$  and  $y$  as

$$x_i = \frac{1}{2} \alpha_{ix} l, \quad y_i = \frac{1}{2} \alpha_{iy} l \quad (4.2h)$$

Substituting equation (4.2h) into utility function (4.2a), we have

$$U_i = \left(\frac{1}{2}\alpha_{ix}l\right)^{0.5} \cdot \left(\frac{1}{2}\alpha_{iy}l\right)^{0.5} = \frac{1}{2}\alpha_{ix}^{0.5}\alpha_{iy}^{0.5}l \quad (4.2i)$$

Structure PC

The decision problem for individuals in the developed country choosing configuration  $(xy/y)_1$  within structure PC is

$$\underset{x_1, x_1^s, y_1, y_1^d, l_{1x}, l_{1y}}{Max}: U_1 = x_1^{0.5} \cdot (y_1 + k_1 y_1^d)^{0.5} \quad (4.3a)$$

$$s.t. \quad x_1 + x_1^s = \alpha_{1x}l_{1x}, \quad y_1 = \alpha_{1y}l_{1y} \quad (4.3b)$$

$$y_1^d = px_1^s, \quad p = \frac{p_x}{p_y} \quad (4.3c)$$

$$l_{1x} + l_{1y} = l \quad (4.3d)$$

Inserting the constraints (4.3b) to (4.3d) into the utility function to eliminate  $x_1, y_1, y_1^d, l_{1y}$  yields the nonconstrained utility maximization problem as

$$\underset{x_1^s, l_{1x}}{Max}: U_1 = (\alpha_{1x}l_{1x} - x_1^s)^{0.5} [\alpha_{1y}(l - l_{1x}) + k_1 px_1^s]^{0.5} \quad (4.3e)$$

The first order conditions for utility maximization are

$$\frac{dU_1}{dx_1^s} = \frac{0.5k_1p(\alpha_{1x}l_{1x} - x_1^s) - 0.5(\alpha_{1y}(l - l_{1x}) + k_1px_1^s)}{U_1} = 0 \quad (4.3f)$$

$$\frac{dU_1}{dl_{1x}} = \frac{-0.5\alpha_{1y}(\alpha_{1x}l_{1x} - x_1^s) + 0.5\alpha_{1x}(\alpha_{1y}(l - l_{1x}) + k_1px_1^s)}{U_1} = 0 \quad (4.3g)$$

From equation (4.3f), we can derive  $x_1^s$  as

$$x_1^s = \frac{\alpha_{1x}l_{1x}}{2} - \frac{\alpha_{1y}(l - l_{1x})}{2k_1p} \quad (4.3h)$$

Substituting equation (4.3h) into equation (4.3g), we can have

$$2l_{1x} - l - \frac{\alpha_{1x}k_1p l_{1x}}{\alpha_{1y}} + \frac{\alpha_{1y}(l - l_{1x})}{\alpha_{1x}k_1p} = 0 \quad (4.3i)$$

For convenience, let  $p_0 = \frac{\alpha_{1x}k_1p}{\alpha_{1y}}$ , we can then express (4.3i) as

$$2l_{1x} - l - p_0 \cdot l_{1x} + \frac{l - l_{1x}}{p_0} = 0 \quad (4.3j)$$

Solutions to equation (4.3j) are

$$p_0 = 1 \quad \text{and} \quad p_0 = \frac{l_{1x} - l}{l_{1x}}$$

Because the individual in the developed country produces both goods  $x$  and  $y$ , we have  $l_{1x} < l$ . Hence, the only solution to equation (4.3j) is  $p_0 = 1$ . That is,

$$p_0 = \frac{\alpha_{1x}k_1p}{\alpha_{1y}} = 1 \quad (4.3k)$$

Therefore, we have the corner equilibrium relative price as

$$p = \frac{\alpha_{1y}}{k_1\alpha_{1x}} \quad (4.3l)$$

We know that the marginal rate of transformation ( $\frac{\alpha_{1y}}{\alpha_{1x}}$ ) in autarky implies the price that an individual pays to produce more good  $x$  in terms of good  $y$  on his/her production frontier. Thus, the intuition here is that the relative price of good  $x$  with respect to good  $y$  discounted by transaction cost in the world market ( $k_1p$ ) equals an individual's marginal rate of transformation ( $\frac{\alpha_{1y}}{\alpha_{1x}}$ ) in the developed country in autarky. Therefore, if  $k_1p < \frac{\alpha_{1y}}{\alpha_{1x}}$ , an individual's optimum decision is to choose autarky. If  $k_1p > \frac{\alpha_{1y}}{\alpha_{1x}}$ , an individual's optimum decision is to specialize in

producing good  $x$  because the marginal utility of specializing in good  $x$  ( $k_1 p$ ) is higher than the marginal utility of producing good  $x$  in autarky.

Substituting equation (4.3l) into equation (4.3h), we solve for the individual's corner supply function for good  $x$  as

$$x_1^s = \alpha_{1x}(l_{1x} - \frac{l}{2}) \quad (4.3m)$$

By inserting this into the constraints (4.3b)-(4.3d), we solve for the corner solution for configuration  $(xy/y)_1$ :

$$\begin{aligned} x_1^s &= \alpha_{1x}(l_{1x} - \frac{l}{2}), \quad x_1 = \frac{1}{2} \alpha_{1x} l \\ y_1 &= \alpha_{1y}(l - l_{1x}), \quad y_1^d = \frac{\alpha_{1y}}{k_1}(l_{1x} - \frac{l}{2}) \end{aligned} \quad (4.3n)$$

Substituting the above solution into utility function (4.4a), we have

$$U_1(xy/y) = \frac{l}{2}(\alpha_{1x}\alpha_{1y})^{0.5} \quad (4.3o)$$

An individual in the developing country choosing configuration  $(y/x)_2$  within structure PC produces only good  $y$  and sells good  $y$  in exchange for good  $x$  from individuals in the developed country. The individual's decision problem can be expressed as

$$\underset{y_2, y_2^s, x_2^d}{Max}: U_2 = (k_2 x_2^d)^{0.5} (y_2)^{0.5} \quad (4.4a)$$

$$s.t. \quad y_2 + y_2^s = \alpha_{2y} l \quad (4.4b)$$

$$y_2^s = p x_2^d, \quad p = \frac{p_x}{p_y} \quad (4.4c)$$

Substituting constraints (4.4b) and (4.4c) into equation (4.4a), we have the unconstrained utility maximization problem as

$$\underset{y_2^s}{Max}: U_2 = (k_2 y_2^s / p)^{0.5} (\alpha_{2y} l - y_2^s)^{0.5} \quad (4.4d)$$

The first order condition with respect to  $y_2^s$  of equation (4.4d) is

$$\frac{dU_2}{dy_2^s} = \frac{0.5k_2(\alpha_{2y}l - y_2^s) - 0.5k_2y_2^s}{(\alpha_{2y}l - y_2^s)^{0.5}(pk_2y_2^s)^{0.5}} = 0 \quad (4.4e)$$

Hence, we can solve for the corner supply function of good  $y$  of an individual in the developing country as

$$y_2^s = \frac{1}{2}\alpha_{2y}l \quad (4.4f)$$

The equilibrium relative price  $p$  has already been solved in equation (4.3l). Substituting equations (4.3l) and (4.4f) into constraints (4.4b) and (4.4c), we solve the decision problem of an individual in the developing country choosing configuration  $(y/x)_2$

$$y_2^s = y_2 = \frac{1}{2}\alpha_{2y}l, \quad x_2 = 0, \quad x_2^d = \frac{\alpha_{1x}\alpha_{2y}k_1l}{2\alpha_{1y}} \quad (4.4g)$$

Substituting the above solution into utility function (4.4a), we have

$$U_2(y/x) = \frac{1}{2}\alpha_{2y}l \left( \frac{\alpha_{1x}k_1k_2}{\alpha_{1y}} \right)^{0.5} \quad (4.4h)$$

Markets of both goods  $x$  and  $y$  are cleared. By Walras' law, we need to consider only the market of good  $x$ . The market clearing condition for market of good  $x$  is

$$M_1x_1^s = M_2x_2^d \quad (4.5a)$$

Substituting optimum corner solution of  $x_1^s$  and  $x_2^d$ , we can obtain the optimum amount of labor which an individual in the developed country allocates into production of good  $x$  as

$$l_{1x} = \frac{l}{2} + \frac{k_1M_2\alpha_{2y}}{2M_1\alpha_{1y}}l \quad (4.5b)$$

Structure CP

In structure CP, the corner equilibrium relative market price is determined by the

developing country producing both goods  $x$  and  $y$ . An individual in the developing country choose configuration  $(xy/x)_2$  within structure CP where he/she produces both goods  $x$  and  $y$  and sells good  $y$  in exchange for good  $x$  from individuals in the developed country. The individual's decision problem can be expressed as follows

$$\underset{x_2, x_2^d, y_2, y_2^s, l_{2x}, l_{2y}}{Max}: U_2 = (x_2 + k_2 x_2^d)^{0.5} (y_2)^{0.5} \quad (4.6a)$$

$$s.t. \quad x_2 = \alpha_{2x} l_{2x}, \quad y_2 + y_2^s = \alpha_{2y} l_{2y} \quad (4.6b)$$

$$y_2^s = p x_2^d, \quad p = \frac{p_x}{p_y} \quad (4.6c)$$

$$l_{2x} + l_{2y} = l \quad (4.6d)$$

Substituting constraints (4.6b) to (4.6d) into equation (4.6a) to eliminate  $x_2, x_2^d, y_2, l_{2y}$ , we have the unconstrained utility maximization problem

$$\underset{y_2^s, l_{2y}}{Max}: U_2 = (\alpha_{2x}(l - l_{2y}) + \frac{k_2 y_2^s}{p})^{0.5} (\alpha_{2y} l_{2y} - y_2^s)^{0.5} \quad (4.6e)$$

The first order conditions for this unconstrained utility maximization are

$$\frac{dU_2}{dy_2^s} = \frac{\frac{0.5k_2(\alpha_{2y} l_{2y} - y_2^s)}{p} - 0.5(\alpha_{2x}(l - l_{2y}) + \frac{k_2 y_2^s}{p})}{U_2} = 0 \quad (4.6f)$$

$$\frac{dU_2}{dl_{2y}} = \frac{-0.5\alpha_{2x}(\alpha_{2y} l_{2y} - y_2^s) + 0.5\alpha_{2y}(\alpha_{2x}(l - l_{2y}) + \frac{k_2 y_2^s}{p})}{U_2} = 0 \quad (4.6g)$$

From condition (4.6f) we have

$$y_2^s = \frac{\alpha_{2y} l_{2y}}{2} - \frac{\alpha_{2x} p (l - l_{2y})}{2k_2} \quad (4.6h)$$

Substituting equation (4.6h) into equation (4.6g), we have



$$(l - 2l_{2y}) - \frac{\alpha_{2x}p(l - l_{2y})}{k_2\alpha_{2y}} + \frac{k_2\alpha_{2y}l_{2y}}{p\alpha_{2x}} = 0 \quad (4.6i)$$

Let  $p_1 = \frac{\alpha_{2x}p}{k_2\alpha_{2y}}$ , then we have  $p_1 > 0$  and

$$(l - 2l_{2y}) - p_1(l - l_{2y}) + \frac{l_{2y}}{p_1} = 0 \quad (4.6j)$$

Solutions to equation (4.6j) with respect to  $p_1$  are

$$p_1 = 1 \text{ and } p_1 = \frac{l_{2y}}{l_{2y} - l}$$

Because the individual in the developing country produces both goods  $x$  and  $y$ , we have  $l_{2y} < l$ . Since  $p_1 > 0$ , the only solution to equation (4.6j) is  $p_1 = 1$ . That is,

$$p_1 = \frac{\alpha_{2x}p}{k_2\alpha_{2y}} = 1 \quad (4.6k)$$

Therefore, we have the corner equilibrium relative price as

$$p = \frac{k_2\alpha_{2y}}{\alpha_{2x}} \quad (4.6l)$$

Substituting equation (4.6l) into equation (4.6h), we solve for the individual's corner equilibrium supply function for good  $y$  as

$$y_2^s = \alpha_{2y}(l_{2y} - \frac{1}{2}l) \quad (4.6m)$$

Substituting equations (4.6l) and (4.6m) into constraints (4.6b) to (4.6d), we solve the decision problem of an individual in the developing country choosing configuration  $(xy/x)_2$  as

$$x_2 = \alpha_{2x}(l - l_{2y}), \quad x_2^d = \frac{\alpha_{2x}(2l_{2y} - l)}{2k_2}, \quad y_2 = \frac{1}{2}\alpha_{2y}l, \quad y_2^s = \alpha_{2y}(l_{2y} - \frac{1}{2}l) \quad (4.6n)$$

Substituting the above solution into utility function (4.6a), we have

$$U_2 = \frac{l}{2}(\alpha_{2x}\alpha_{2y})^{0.5} \quad (4.6o)$$

Within market structure CP, an individual in the developed country chooses configuration  $(x/y)_1$  where he/she produces only good  $x$  and sells it in exchange for good  $y$  from individuals in the developed country. The individual's decision problem can be expressed as follows

$$\underset{x_1, x_1^s, y_1^d}{Max}: U_1 = (x_1)^{0.5} (k_1 y_1^d)^{0.5} \quad (4.7a)$$

$$s.t. \quad x_1 + x_1^s = \alpha_{1x}l \quad (4.7b)$$

$$y_1^d = p x_1^s, \quad p = \frac{p_x}{p_y} \quad (4.7c)$$

Substituting constraints (4.7b) and (4.7c) into equation (4.7a), we convert the constrained utility maximization problem into an unconstrained utility maximization problem as

$$\underset{x_1^s}{Max}: U_1 = (\alpha_{1x}l - x_1^s)^{0.5} (k_1 p x_1^s)^{0.5} \quad (4.7d)$$

The first order condition with respect to  $x_1^s$  of equation (4.7d) is

$$\frac{dU_1}{dx_1^s} = \frac{0.5k_1 p(\alpha_{1x}l - x_1^s) - 0.5k_1 p x_1^s}{U_1} = 0 \quad (4.7e)$$

We solve for the corner equilibrium supply function of good  $x$  of an individual in the developed country as

$$x_1^s = \frac{1}{2} \alpha_{1x}l \quad (4.7f)$$

Substituting equation (4.7f) and equilibrium relative price equation (4.6l) into constraints (4.7b) and (4.7c), we can solve the decision problem of an individual in the developed country choosing configuration  $(x/y)_1$  as

$$x_1 = x_1^s = \frac{1}{2} \alpha_{1x}l, \quad y_1^d = \frac{\alpha_{1x}\alpha_{2y}k_2l}{2\alpha_{2x}} \quad (4.7g)$$

Substituting the above solution into utility function (4.7a), we have

$$U_1(x/y) = \frac{1}{2} \alpha_{1x} l \left( \frac{\alpha_{2y} k_1 k_2}{\alpha_{2x}} \right)^{0.5} \quad (4.7h)$$

The market clearing condition for market of good  $x$  is

$$M_1 x_1^s = M_2 x_2^d \quad (4.8a)$$

Substituting optimum corner solution of  $x_1^s$  and  $x_2^d$ , as shown in (4.7g) and (4.6n), into equation (4.8a), we can obtain the optimum amount of labor which an individual in the developing country allocates into production of good  $y$  as

$$l_{2y} = \frac{l}{2} + \frac{M_1 \alpha_{1x} k_2 l}{2 M_2 \alpha_{2x}} \quad (4.8b)$$

#### Structure CC

Within market structure CC, the corner equilibrium relative price is determined by both countries. An individual in the developed country chooses configuration  $(x/y)_1$  where he/she produces only good  $x$  and sells it in exchange for good  $y$  from individuals in the developed country. The individual's decision problem can be expressed the same as in equations (4.7a) to (4.7c). Thus, we can solve for the corner equilibrium supply and demand functions of an individual in the developed country choosing configuration  $(x/y)_1$

$$x_1 = x_1^s = \frac{1}{2} \alpha_{1x} l, \quad y_1^d = \frac{p \alpha_{1x} l}{2} \quad (4.9a)$$

Within structure CC, an individual in the developing country chooses configuration  $(y/x)_2$  where he/she produces only good  $y$  and sells good  $y$  in exchange for good  $x$  from individuals in the developed country. The individual's decision problem can be expressed the same as in equations (4.4a) to (4.4c). Thus, we solve for the corner equilibrium supply and demand

functions of an individual in the developing country choosing configuration  $(y/x)_2$

$$y_2 = y_2^s = \frac{1}{2} \alpha_{2y} l, \quad x_2^d = \frac{\alpha_{2y} l}{2p} \quad (4.9b)$$

The market clearing condition for market of good  $x$  is

$$M_1 x_1^s = M_2 x_2^d \quad (4.9c)$$

Substituting optimum corner solution of  $x_1^s$  and  $x_2^d$ , as shown in (4.9a) and (4.9b), into equation (4.9c), we obtain the corner equilibrium relative price under market structure as

$$p = \frac{M_2 \alpha_{2y}}{M_1 \alpha_{1x}} \quad (4.9d)$$

Plugging the corner equilibrium relative price into equation (4.9a) and (4.9b), we have

$$y_1^d = \frac{M_2}{2M_1} \alpha_{2y} l \quad (4.9e)$$

$$x_2^d = \frac{M_1}{2M_2} \alpha_{1x} l \quad (4.9f)$$

Substituting the corner equilibrium supply and demand functions into the utility functions for the representative individuals in both countries (equations (4.7a) and (4.4a)), we have

$$U_1(x/y) = \frac{l}{2} \left( \frac{k_1 M_2 \alpha_{1x} \alpha_{2y}}{M_1} \right)^{0.5} \quad (4.9g)$$

$$U_2(y/x) = \frac{l}{2} \left( \frac{M_1 k_2 \alpha_{1x} \alpha_{2y}}{M_2} \right)^{0.5} \quad (4.9h)$$

We summarize our solutions to all four corner equilibrium in the Ricardian model in Table 4.1.

#### 4.1.2b. Second step: Total const-benefit analysis on each corner equilibrium

Now we carry out the total benefit-cost analysis on each corner equilibrium in order to

identify the parameter subspace within which the corner equilibrium is the general equilibrium.

A general equilibrium is a corner equilibrium that individuals maximize their utility in their chosen configuration under the corner equilibrium relative prices.

#### Structure PC

Structure PC is the general equilibrium structure if and only if the following three conditions hold. First, under the corner equilibrium relative price in this structure  $p = \frac{\alpha_{1y}}{k_1\alpha_{1x}}$ , individuals in the developed country prefer configuration  $(xy/y)_1$  to the alternatives, namely configuration  $(x/y)_1$  and configuration  $(y/x)_1$ . Thus, we have

$$U_1(xy/y) \geq U_1(x/y) \quad (4.10a)$$

$$U_1(xy/y) \geq U_1(y/x) \quad (4.10b)$$

From equations (4.7f), (4.7b) and (4.7c), we know that the demand and supply functions for an individual in the developed country choosing configuration  $(x/y)$  are

$$x_1 = x_1^s = \frac{1}{2}\alpha_{1x}l, \quad y_1^d = \frac{1}{2}p\alpha_{1x}l \quad (4.10c)$$

Substituting equation (4.10c) into utility function (4.7a), we can have the utility function for an individual in the developed country choosing configuration  $(x/y)$  as

$$U_1(x/y) = \frac{1}{2}\alpha_{1x}l(k_1p)^{0.5} \quad (4.10d)$$

Under the corner equilibrium relative price  $p = \frac{\alpha_{1y}}{k_1\alpha_{1x}}$ , we have the utility function as

$$U_1(x/y) = \frac{l}{2}(\alpha_{1x}\alpha_{1y})^{0.5} \quad (4.10e)$$

Inserting equations (4.10e) and (4.3o) into (4.10a), we have

$$U_1(xy/y) = \frac{l}{2}(\alpha_{1x}\alpha_{1y})^{0.5} \geq U_1(x/y) = \frac{l}{2}(\alpha_{1x}\alpha_{1y})^{0.5} \quad (4.10f)$$

This is always true.

For an individual in the developed country choosing configuration  $(y/x)_1$ , the decision problem can be expressed in the same way as in equation systems (4.4a) to (4.4c) except changing the subscript  $i$  from  $i = 2$  to  $i = 1$ . Thus, we have the corner solution as

$$y_1 = y_1^s = \frac{1}{2}\alpha_{1y}l, \quad x_1^d = \frac{1}{2p}\alpha_{1y}l, \quad U_1(y/x) = \frac{\alpha_{1y}l}{2}\left(\frac{k_1}{p}\right)^{0.5} \quad (4.10g)$$

Substitution of the corner equilibrium relative price  $p = \frac{\alpha_{1y}}{k_1\alpha_{1x}}$  in this structure PC yields

$$U_1(y/x) = \frac{k_1l}{2}(\alpha_{1x}\alpha_{1y})^{0.5} \quad (4.10h)$$

Substituting equations (4.10h) and (4.3o) into inequality (4.10a), we have

$$U_1(xy/y) = \frac{l}{2}(\alpha_{1x}\alpha_{1y})^{0.5} \geq U_1(y/x) = \frac{k_1l}{2}(\alpha_{1x}\alpha_{1y})^{0.5} \quad (4.10i)$$

This inequality holds iff  $k_1 \leq 1$  which is our assumption about the transaction efficiency.

Second, individuals in the developing country prefer configuration  $(y/x)$  to the alternatives, that is,

$$U_2(y/x) \geq U_2(A) \quad (4.11a)$$

$$U_2(y/x) \geq U_2(x/y) \quad (4.11b)$$

Substituting equations (4.2i) and (4.4h) into inequality (4.11a), we have

$$U_2(y/x) = \frac{1}{2}\alpha_{2y}l\left(\frac{\alpha_{1x}k_1k_2}{\alpha_{1y}}\right)^{0.5} \geq U_2(A) = \frac{1}{2}\alpha_{2x}^{0.5}\alpha_{2y}^{0.5}l \quad (4.11c)$$

This holds if and only if

$$k_1 k_2 \geq \frac{\alpha_{1y}}{\alpha_{1x}} \frac{\alpha_{2x}}{\alpha_{2y}} \quad (4.11d)$$

Otherwise, the individual in the developing country will choose configuration (A) if

$$k_1 k_2 \leq \frac{\alpha_{1y}}{\alpha_{1x}} \frac{\alpha_{2x}}{\alpha_{2y}}$$

Combining this result with the assumption that  $0 \leq k_2 \leq k_1 \leq 1$ , inequality (4.11d) implies that

$$k_1 \geq k_2 \geq k_1 k_2 \geq \frac{\alpha_{1y} \alpha_{2x}}{\alpha_{1x} \alpha_{2y}} \quad (4.11e)$$

For an individual in the developing country choosing configuration  $(x/y)_2$ , the decision problem can be expressed in the same way as in equation systems (4.7a) to (4.7c) except changing the subscript  $i$  from  $i=1$  to  $i=2$ . Similar to equation (4.10d), we have the corner equilibrium utility function as

$$U_2(x/y) = \frac{1}{2} \alpha_{2x} l(k_2 p)^{0.5} \quad (4.11f)$$

Under the corner equilibrium relative price  $p = \frac{\alpha_{1y}}{k_1 \alpha_{1x}}$ , we have the utility function as

$$U_2(x/y) = \frac{1}{2} \alpha_{2x} l\left(\frac{k_2 \alpha_{1y}}{k_1 \alpha_{1x}}\right)^{0.5} \quad (4.11g)$$

Inserting equations (4.2i) and (4.11g) into (4.11b), we have

$$U_2(y/x) = \frac{1}{2} \alpha_{2y} l\left(\frac{\alpha_{1x} k_1 k_2}{\alpha_{1y}}\right)^{0.5} \geq U_2(x/y) = \frac{1}{2} \alpha_{2x} l\left(\frac{k_2 \alpha_{1y}}{k_1 \alpha_{1x}}\right)^{0.5} \quad (4.11h)$$

This holds if and only if

$$k_1 \geq \frac{\alpha_{1y}}{\alpha_{1x}} \frac{\alpha_{2x}}{\alpha_{2y}} \quad (4.11i)$$

Third, no individual in country 1 is completely specialized in good  $x$ , i.e.,

$$l_{1x} < 1 \quad (4.12a)$$

Substituting equation (4.5b) into the above inequality, we have

$$l_{1x} = \frac{l}{2} + \frac{k_1 M_2 \alpha_{2y}}{2 M_1 \alpha_{1y}} l < 1 \quad (4.12b)$$

This holds true if and only if

$$k_1 < \frac{M_1 \alpha_{1y}}{M_2 \alpha_{2y}} \quad (4.12c)$$

In order to have inequality (4.11h) and (4.12c) hold true at the same time, we have

$$\frac{M_1}{M_2} > \frac{\alpha_{2x}}{\alpha_{1x}} \quad (4.12d)$$

Inequalities (4.10f), (4.10i), (4.11d), (4.11i), (4.12c) and (4.12d) define a parameter subspace as

$$\min(1, \frac{M_1 \alpha_{1y}}{M_2 \alpha_{2y}}) > k_1 \geq k_1 k_2 \geq \frac{\alpha_{1y} \alpha_{2x}}{\alpha_{1x} \alpha_{2y}}, \quad k_2 \geq \frac{\alpha_{1y}}{\alpha_{1x}} \frac{\alpha_{2x}}{\alpha_{2y}}, \quad \frac{M_1}{M_2} > \frac{\alpha_{2x}}{\alpha_{1x}} \quad (4.12e)$$

Within this parameter subspace, structure PC is the general equilibrium.

Structure CP

Structure CP is the general equilibrium structure if and only if the following three conditions hold. First, under the corner equilibrium relative price in this structure  $p = \frac{k_2 \alpha_{2y}}{\alpha_{2x}}$ , individuals in the developed country prefer configuration  $(x/y)_1$  to the alternatives, namely configuration  $(A)_1$  and configuration  $(y/x)_1$ . Thus, we have

$$U_1(x/y) \geq U_1(A) \quad (4.13a)$$



$$U_1(x/y) \geq U_1(y/x) \quad (4.13b)$$

Substituting equations (4.2i) and (4.7h) into inequality (4.13a), we have

$$U_1(x/y) = \frac{1}{2} \alpha_{1x} l \left( \frac{\alpha_{2y} k_1 k_2}{\alpha_{2x}} \right)^{0.5} \geq U_1(A) = \frac{1}{2} \alpha_{1x}^{0.5} \alpha_{1y}^{0.5} l \quad (4.13c)$$

This holds true if and only if

$$k_1 k_2 \geq \frac{\alpha_{1y} \alpha_{2x}}{\alpha_{1x} \alpha_{2y}} \quad (4.13d)$$

Otherwise, the individual in the developed country will choose configuration (A) if

$$k_1 k_2 \leq \frac{\alpha_{1y} \alpha_{2x}}{\alpha_{1x} \alpha_{2y}}$$

Combining this result with the assumption of  $0 \leq k_2 \leq k_1 \leq 1$ , inequality (4.13d) implies that

$$k_1 \geq k_2 \geq k_1 k_2 \geq \frac{\alpha_{1y} \alpha_{2x}}{\alpha_{1x} \alpha_{2y}} \quad (4.13e)$$

From equation (4.10g), we know that

$$U_1(y/x) = \frac{\alpha_{1y} l}{2} \left( \frac{k_1}{p} \right)^{0.5} \quad (4.13f)$$

Under the corner equilibrium relative price  $p = \frac{k_2 \alpha_{2y}}{\alpha_{2x}}$  in structure CP, we have

$$U_1(y/x) = \frac{\alpha_{1y} l}{2} \left( \frac{k_1 \alpha_{2x}}{k_2 \alpha_{2y}} \right)^{0.5} \quad (4.13g)$$

Substituting equations (4.2i) and (4.13g) into inequality (4.13a), we have

$$U_1(x/y) = \frac{1}{2} \alpha_{1x} l \left( \frac{\alpha_{2y} k_1 k_2}{\alpha_{2x}} \right)^{0.5} \geq U_1(y/x) = \frac{\alpha_{1y} l}{2} \left( \frac{k_1 \alpha_{2x}}{k_2 \alpha_{2y}} \right)^{0.5} \quad (4.13h)$$

This holds true if and only if

$$k_2 \geq \frac{\alpha_{1y}\alpha_{2x}}{\alpha_{1x}\alpha_{2y}} \quad (4.13i)$$

Second, individuals in the developing country prefer configuration  $(xy/x)$  to the alternatives, namely configuration  $(y/x)_2$  and configuration  $(x/y)_2$ . Thus, we have

$$U_2(xy/x) \geq U_2(y/x) \quad (4.14a)$$

$$U_2(xy/x) \geq U_2(x/y) \quad (4.14b)$$

Substituting equation (4.9b) into utility function (4.4a), we have

$$U_2(y/x) = \frac{\alpha_{2y}l}{2} \left( \frac{k_2}{p} \right)^{0.5} \quad (4.14c)$$

Under the corner equilibrium relative price  $p = \frac{k_2\alpha_{2y}}{\alpha_{2x}}$  in structure CP, we have

$$U_2(y/x) = \frac{l}{2} (\alpha_{2x}\alpha_{2y})^{0.5} \quad (4.14d)$$

Substituting equations (4.6o) and (4.14d) into inequality (4.14a), we have

$$U_2(xy/x) = \frac{l}{2} (\alpha_{2x}\alpha_{2y})^{0.5} \geq U_2(y/x) = \frac{l}{2} (\alpha_{2x}\alpha_{2y})^{0.5} \quad (4.14e)$$

This always holds true.

Substituting the corner equilibrium relative price  $p = \frac{k_2\alpha_{2y}}{\alpha_{2x}}$  in structure CP into equation (4.11f), we have

$$U_2(x/y) = \frac{1}{2} k_2 l (\alpha_{2x}\alpha_{2y})^{0.5} \quad (4.14f)$$

Substituting equations (4.6o) and (4.14f) into inequality (4.14b), we have

$$U_2(xy/x) = \frac{l}{2} (\alpha_{2x}\alpha_{2y})^{0.5} \geq U_2(x/y) = \frac{1}{2} k_2 l (\alpha_{2x}\alpha_{2y})^{0.5} \quad (4.14g)$$

Hence, we obtain that

$$k_2 \leq 1 \quad (4.14h)$$

Third, no individual in the developing country is completely specialized in good  $y$ , i.e.,

$$l_{2y} < l \quad (4.15a)$$

Substituting equation (4.8b) into inequation (4.15a), we have

$$l_{2y} = \frac{l}{2} + \frac{M_1 \alpha_{1x} k_2 l}{2M_2 \alpha_{2x}} < l \quad (4.15b)$$

Hence, we can derive

$$k_2 < \frac{M_2 \alpha_{2x}}{M_1 \alpha_{1x}} \quad (4.15c)$$

Inequalities (4.13e), (4.13i), (4.14h) and (4.15c) defines a parameter subspace as

$$k_1 \geq k_2 \geq k_1 k_2 \geq \frac{\alpha_{1y} \alpha_{2x}}{\alpha_{1x} \alpha_{2y}}, \quad k_2 \geq \frac{\alpha_{1y} \alpha_{2x}}{\alpha_{1x} \alpha_{2y}}, \quad k_2 < \min\left\{\frac{M_2 \alpha_{2x}}{M_1 \alpha_{1x}}, 1\right\}$$

Within this parameter subspace, structure PC is the general equilibrium.

Structure CC

Structure CC is the general equilibrium structure if and only if the following two conditions hold. First, under the corner equilibrium relative price in this structure  $p = \frac{M_2 \alpha_{2y}}{M_1 \alpha_{1x}}$ ,

individuals in the developed country prefer configuration  $(x/y)_1$  to the alternatives, namely configuration  $(A)_1$  and configuration  $(y/x)_1$ . Thus, we have

$$U_1(x/y) \geq U_1(A) \quad (4.16a)$$

$$U_1(x/y) \geq U_1(y/x) \quad (4.16b)$$

Substituting equations (4.2i) and (4.9g) into inequation (4.16a), we have

$$U_1(x/y) = \frac{l}{2} \left( \frac{k_1 M_2 \alpha_{1x} \alpha_{2y}}{M_1} \right)^{0.5} \geq U_1(A) = \frac{1}{2} \alpha_{1x}^{0.5} \alpha_{1y}^{0.5} l \quad (4.16c)$$

Simplification of (4.16c) yields

$$k_1 \geq \frac{M_1 \alpha_{1y}}{M_2 \alpha_{2y}} \quad (4.16d)$$

Substituting the corner equilibrium relative price  $p = \frac{M_2 \alpha_{2y}}{M_1 \alpha_{1x}}$  into equation (4.13f), we

have

$$U_1(y/x) = \frac{\alpha_{1y} l}{2} \left( \frac{k_1 M_1 \alpha_{1x}}{M_2 \alpha_{2y}} \right)^{0.5} \quad (4.16e)$$

Substitution of equations (4.9g) and (4.16e) into inequation (4.16b) yields

$$U_1(x/y) = \frac{l}{2} \left( \frac{k_1 M_2 \alpha_{1x} \alpha_{2y}}{M_1} \right)^{0.5} \geq U_1(y/x) = \frac{\alpha_{1y} l}{2} \left( \frac{k_1 M_1 \alpha_{1x}}{M_2 \alpha_{2y}} \right)^{0.5} \quad (4.16f)$$

Simplification of (4.16f) yields

$$\frac{M_1}{M_2} \leq \frac{\alpha_{2y}}{\alpha_{1y}} \quad (4.16g)$$

Second, individuals in the developing country prefer configuration (y/x) to the alternatives, namely configuration (A)<sub>2</sub> and configuration (x/y)<sub>2</sub>. Thus, we have

$$U_2(y/x) \geq U_2(A) \quad (4.17a)$$

$$U_2(y/x) \geq U_2(x/y) \quad (4.17b)$$

Substitution of equations (4.2i) and (4.9h) into inequation (4.17a) produces

$$U_2(y/x) = \frac{l}{2} \left( \frac{M_1 k_2 \alpha_{1x} \alpha_{2y}}{M_2} \right)^{0.5} \geq U_2(A) = \frac{1}{2} \alpha_{2x}^{0.5} \alpha_{2y}^{0.5} l \quad (4.17c)$$

That is,

$$k_2 \geq \frac{M_2 \alpha_{2x}}{M_1 \alpha_{1x}} \quad (4.17d)$$

Substituting the corner equilibrium relative price  $p = \frac{M_2 \alpha_{2y}}{M_1 \alpha_{1x}}$  into equation (4.11f), we have

$$U_2(x/y) = \frac{1}{2} \alpha_{2x} l \left( \frac{k_2 M_2 \alpha_{2y}}{M_1 \alpha_{1x}} \right)^{0.5} \quad (4.17e)$$

Substitution of equations (4.9h) and (4.17e) into inequation (4.17b) produces

$$U_2(y/x) = \frac{l}{2} \left( \frac{M_1 k_2 \alpha_{1x} \alpha_{2y}}{M_2} \right)^{0.5} \geq U_2(x/y) = \frac{1}{2} \alpha_{2x} l \left( \frac{k_2 M_2 \alpha_{2y}}{M_1 \alpha_{1x}} \right)^{0.5} \quad (4.17f)$$

That is,

$$\frac{\alpha_{2x}}{\alpha_{1x}} \leq \frac{M_1}{M_2} \quad (4.17g)$$

Since we assume that  $\alpha_{2y} < \alpha_{1y}$ , inequations (4.16d), (4.16g), (4.17d) and (4.17g) defines a parameter subspace as

$$k_1 \geq \frac{M_1 \alpha_{1y}}{M_2 \alpha_{2y}}, \quad \frac{\alpha_{2x}}{\alpha_{1x}} \leq \frac{M_1}{M_2} \leq \frac{\alpha_{2y}}{\alpha_{1y}} < 1, \quad k_2 \geq \frac{M_2 \alpha_{2x}}{M_1 \alpha_{1x}}$$

Table 4.2 summarizes the partitioned parameter subspaces and the corresponding general equilibrium structures. If the trading efficiency in the two countries are low enough such that  $k_1 k_2 < \frac{\alpha_{2x} \alpha_{1y}}{\alpha_{1x} \alpha_{2y}}$ , the general equilibrium structure is autarky (structure AA). As the trading

efficiency in the two countries increases, the general equilibrium will discontinuously jump to partial division of labor (structure PC and structure CP) and even the complete division of labor

(structure CC). If  $k_1 > \frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}, k_2 > \frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}, k_2 < k_1 < \frac{M_1\alpha_{1y}}{M_2\alpha_{2y}}$ , and  $\frac{M_1}{M_2} > \frac{\alpha_{2x}}{\alpha_{1x}}$ , the general equilibrium will occur in structure PC. If  $k_1 > \max(\frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}, \frac{M_1\alpha_{1y}}{M_2\alpha_{2y}})$ ,  $\frac{M_2\alpha_{2x}}{M_1\alpha_{1x}} > k_2 > \frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}$ , and  $\frac{M_1}{M_2} < \frac{\alpha_{2y}}{\alpha_{1y}} < 1$ , the general equilibrium will occur in structure CP. If  $k_1 > \max(\frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}, \frac{M_1\alpha_{1y}}{M_2\alpha_{2y}})$ ,  $k_2 > \max(\frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}, \frac{M_2\alpha_{2x}}{M_1\alpha_{1x}})$ , and  $\frac{\alpha_{2x}}{\alpha_{1x}} < \frac{M_1}{M_2} < \frac{\alpha_{2y}}{\alpha_{1y}} < 1$ , the general equilibrium will occur in structure CC in which both countries choose to completely specialize in producing its advantaged good.

One immediate finding is that the developing country must have a larger population size than the developed country has, that is  $M_1 < M_2$ , in order to have the general equilibrium occur in structure CP and CC. The general equilibrium structure of division of labor is determined by their transaction efficiencies in both countries together. The lower transaction efficiency in the developing country tends to pull the general equilibrium structure toward the lower level of division of labor. The higher transaction efficiency in the developed country tends to push the general equilibrium structure toward the higher level of division of labor. This demonstrates the interdependency between the two countries and justifies that the developed country has the responsibility to help the developing country in order to benefit more from a higher level of division of labor.

#### 4.1.3. General Equilibrium Analysis

All four corner equilibrium structures can be the general equilibrium structure within certain parameter subspaces. Marginal analysis in Table 4.1 shows that individuals' utility (per

capita real income) in a country is proportional to its productivities in both sectors if a country chooses autarky. If a country chooses complete specialization in its comparatively advantaged good (the developing country in structures PC and CC and the developed country in structures CP and CC), individuals' utility in this country is positively related to productivity in its comparatively advantaged good only instead of productivity in both goods. When a country participates only in partial division of labor (the developed country in structure PC and the developing country in structure CP), individuals' utility in this country is the same as in the autarky. However, a division of labor may still evolve.

Let's examine the developing country in structure CP. As the transaction efficiency in the developing country ( $k_2$ ) increases, the demand for good  $y$  from the developed country ( $y_1^d$ ) also increases. Responding to the increased demand of good  $y$ , the developing country will allocate more labor from the comparatively disadvantaged good  $x$  ( $l_{2x}$ ) to the comparatively advantaged good  $y$  ( $l_{2y}$ ) in order to increase the supply of good  $y$ . As a result, the division of labor evolves to a higher level and increases the gains from trade. However, individuals' utility in the developing country remains the same because the developed country reaps all gains from trade.

The relative productivity of the comparatively advantaged good ( $\frac{\alpha_{1x}}{\alpha_{2x}}$ ) and the relative population size ( $\frac{M_1}{M_2}$ ) between two countries may also induce the evolution of division of labor.

The larger the relative productivity ( $\frac{\alpha_{1x}}{\alpha_{2x}}$ ), the more comparative advantage the developed country has in good  $x$ . The demand for good  $y$  of the developed country ( $y_1^d$ ) increases as the

relative productivity ( $\frac{\alpha_{1x}}{\alpha_{2x}}$ ) expands. To meet the increased demand for good  $y$  ( $y_1^d$ ), the developing country will shift labor from the more comparatively disadvantaged good  $x$  to the more comparatively advantaged good  $y$ . In another word,  $l_{2y}$  will increase. Such a shifting of labor increases the gains from trade, but all of them are reaped by the developed country. As the relative population size ( $\frac{M_1}{M_2}$ ) increases, the aggregate market demand for good  $y$  from the developed country, averaged by the population in the developing country ( $\frac{M_1}{M_2} y_1^d$ ), increases. Consequently, the developing country will shift labor from the more comparatively disadvantaged good  $x$  to the more comparatively advantaged good  $y$ .

Inframarginal analysis shows that as the trading efficiency and productivities in both countries improve, the general equilibrium market structure may discontinuously jump from structure PC (or CP) to structure CC. The country in partial division of labor switches to complete division of labor and the welfare in both countries increase correspondingly.

Marginal analysis also shows that as trading efficiency is improved in the large country<sup>4</sup>, terms of trade deteriorate for the large country and improve for the small country. However, the deterioration in terms of trade does not necessarily lead to a decrease in per capita real income in the country. Take structure CP as an example, the developing country (large country) produces both goods  $x$  and  $y$  and sells good  $y$  for good  $x$  from the developed country (small country). As trading efficiencies are improved in both countries, terms of trade for the developing country

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<sup>4</sup> Here a large country refers to the country who produces both goods  $x$  and  $y$  and determines the equilibrium relative price. Similarly, a small country refers to the country who produces only one good and takes the equilibrium relative price as given.



deteriorate because the relative price of good  $x$  to good  $y$  increases. However, per capita real income remains the same in the developing country and increases in the developed country.

The inframarginal comparative statics even show that per capita real income may increase regardless of the deterioration in terms of trade. Suppose that the initial general equilibrium structure is CP where the developing country determines the relative price at

$p = \frac{k_2 \alpha_{2y}}{\alpha_{2x}}$ . As the trading efficiency is improved in both countries, the general equilibrium may

discontinuously jump from structure CP to structure CC where the relative price is  $p' = \frac{M_2 \alpha_{2y}}{M_1 \alpha_{1x}}$ .

Under the given parameter subspace where structure CP is the general equilibrium, we have

$k_2 < \frac{M_2 \alpha_{2x}}{M_1 \alpha_{1x}}$  and thus  $p = \frac{k_2 \alpha_{2y}}{\alpha_{2x}} < p' = \frac{M_2 \alpha_{2y}}{M_1 \alpha_{1x}}$ . The relative price of good  $x$  to good  $y$

increases, so the terms of trade have deteriorated for the developing country as the general equilibrium structure switches from structure CP to structure PC. Yet we observe that per capita real income in the developing country increases in moving from structure CP to structure CC. Therefore, as trading efficiency is improved under the given parameter subspace, the per capita real income in the developing country may even increase regardless of the deterioration in terms of trade.

We can illustrate the market structures and their associated aggregate production schedules using Figure 4.2. Line AB and CD represent the production schedules of the developed country and the developing country, respectively. Point G (E) indicates the aggregate production level if both countries choose to completely specialize in producing good  $x$  (good  $y$ ) and line EG

is the aggregate production schedules of both countries if autarky is the general equilibrium. Point H denotes market structure C that both countries completely specialize in producing their comparative advantaged good and trade with each other. Line EH represents market structure PC and line HG represents market structure CP. Triangle EHG represents the increased aggregate production based on specialization and division of labor compared to the autarky economy. As trading efficiency is improved, the equilibrium aggregate productivity will discontinuously jump from line EG to line EHG.

This is aggregate productivity gain from division of labor. Even though under the constant return to scale technology, such as our Ricardian production technology, aggregate productivity can still increase as production specialization and division of labor increase. Yang defines this increased aggregate production as economies of division of labor (Yang, 2001). This is similar to the gain analysis in traditional trade theory. The difference here is that in our new classical economics model we have corner equilibriums as general equilibriums by allowing for corner solutions. Thus, the general equilibrium may not necessarily lead to a single stable equilibrium.

#### **4.2. New Classical General Equilibrium Trade Model: Introduction of Tariff**

Each individual country is more concerned more about its share of the gain accrued rather than the aggregate productivity gain to the international society. Even though there exist aggregate productivity gains from division of labor and free trade, these two countries may not necessarily choose to have free trade. As we can see from Table 4.1, the gains from division of

labor are distributed unequally. With the improvement of trading efficiency, the general market equilibrium switches from the autarky structure to structure PC (CP). The developed (developing) country receives no gain from production specialization and division of labor in moving from structure AA to structure PC (CP). All the gains from trade go to the other country. Thus, the developed (developing) country may have incentives to impose some trade policy instruments, such as a tariff, to grab some gains or a larger share of gains.

Suppose country  $i$  ( $i=1, 2$ ) imposes an *ad valorem* tariff,  $t_i$ , on the imported good and then transfers the tariff revenue evenly to all its residents. We further assume that only  $\mu_i$  percent of the total tariff revenue in country  $i$  is transferred to individuals. In other words,  $\mu_i$  indicates the transfer efficiency of tariff revenues where  $0 \leq \mu_i \leq 1$ . If  $\mu_i < 1$ , tariff revenue may either be used for governmental administration purposes or be dissipated due to government corruption and rent-seeking activities. If  $\mu_i = 1$ , tariff revenue in country  $i$  is fully transferred to its residents. For simplicity, we solve for the corner solutions for each possible market structure only for  $\mu_i = 0$  and  $\mu_i = 1$ . The following calculation are presented for  $\mu_i = 1$ .

#### Structure PC

Individuals in the developed country choose configuration  $(xy/y)_1$  and their decision problem is:

$$\underset{x_1, x_1^s, y_1, y_1^d, l_{1x}, l_{1y}}{Max}: U_1 = x_1^{0.5} \cdot (y_1 + k_1 y_1^d)^{0.5} \quad (4.18a)$$

$$s.t. \quad x_1 + x_1^s = \alpha_{1x} l_{1x}, \quad y_1 = \alpha_{1y} l_{1y} \quad (4.18b)$$

$$l_{1x} + l_{1y} = l \quad (4.18c)$$

$$(1+t_1)p_y y_1^d = p_x x_1^s + R_1 \quad (4.18d)$$

where  $R_1$  is the transfer payment from tariff revenues received by residents in the developed country. The transfer payment equation is

$$R_1 = t_1 p_y y_1^d \quad (4.18e)$$

In equilibrium, the post-tariff price of good  $x$  with respect to good  $y$  discounted by the transaction cost in the world market ( $\frac{k_1 p}{1+t_1}$ ) equals the marginal rate of transformation ( $\frac{\alpha_{1y}}{\alpha_{1x}}$ ). If

$\frac{k_1 p}{1+t_1} < \frac{\alpha_{1y}}{\alpha_{1x}}$ , an individual's optimum decision is to choose autarky because the marginal utility

of specializing in producing good  $x$  is lower than the marginal utility of producing both goods in

autarky. If  $\frac{k_1 p}{1+t_1} > \frac{\alpha_{1y}}{\alpha_{1x}}$ , an individual's optimum decision is to specialize in production of

good  $x$ . Thus, we have the corner equilibrium price as

$$p = \frac{(1+t_1)\alpha_{1y}}{k_1 \alpha_{1x}} \quad (4.18f)$$

From equations (4.18d), we have

$$y_1^d = \frac{p x_1^s}{1+t_1} + \frac{R_1}{(1+t_1)p_y} \quad (4.18g)$$

Substituting equations (4.18b), (4.18c) and (4.18g) into the utility equation (4.18a), we have

$$U_1 = (\alpha_{1x} l_{1x} - x_1^s)^{0.5} \cdot (\alpha_{1y} (l - l_{1x}) + \frac{k_1 p x_1^s}{(1+t_1)} + \frac{k_1 R_1}{(1+t_1)p_y})^{0.5} \quad (4.18h)$$

The first order condition with respect to  $x_1^s$ ,  $\frac{dU_1}{dx_1^s} = 0$  is

$$\frac{dU_1}{dx_1^s} = \frac{0.5k_1p(\alpha_{1x}l_{1x} - x_1^s) - 0.5(\alpha_{1y}(l - l_{1x}) + k_1px_1^s + k_1R_1 / p_y)}{U_1(1+t_1)} = 0 \quad (4.18i)$$

Validating at  $R_1 = t_1 p_y y_1^d$ , we have

$$x_1^s = \frac{\alpha_{1x}(2l_{1x} - l)}{2 + t_1} \quad (4.18j)$$

Substituting equations (4.18e) and (4.18j) into equation (4.18g), we have

$$y_1^d = \frac{(1+t_1)(2l_{1x} - l)\alpha_{1y}}{(2+t_1)k_1} \quad (4.18k)$$

Substitution of equation (4.18j) into equation (4.18b) yields

$$x_1 = \alpha_{1x} \frac{l + t_1 l_{1x}}{2 + t_1} \quad (4.18l)$$

Substituting equations (4.18j) through (4.18l) into utility function (4.18a), we have

$$U_1(xy/y) = \frac{l + t_1 l_{1x}}{2 + t_1} (\alpha_{1x} \alpha_{1y})^{0.5} \quad (4.18m)$$

Individuals in the developing country choose configuration  $(y/x)_2$  and their decision problem is

$$\underset{y_2, y_2^s, x_2^d}{Max}: U_2 = (k_2 x_2^d)^{0.5} (y_2)^{0.5} \quad (4.19a)$$

$$s.t. \quad y_2 + y_2^s = \alpha_{2y} l \quad (4.19b)$$

$$p_y y_2^s + R_2 = (1+t_2) p_x x_2^d \quad (4.19c)$$

$$R_2 = t_2 p_x x_2^d \quad (4.19d)$$

The equilibrium relative price is determined by the developed country at

$$p = \frac{p_x}{p_y} = \frac{(1+t_1)\alpha_{1y}}{k_1\alpha_{1x}} \quad (4.19e)$$

From equation (4.19c) we have

$$y_2^s = (1+t_2)px_2^d - \frac{R_2}{p_y} \quad (4.19f)$$

Substituting constraint equations (4.19b) to (4.19e) and (4.19f), we have the unconstrained utility maximization problem as

$$Max_{x_2^d} : U_2 = (k_2 x_2^d)^{0.5} (\alpha_{2y} l - (1+t_2) p x_2^d + \frac{R_2}{p_y})^{0.5} \quad (4.19g)$$

The first order condition with respect to  $x_2^d$ ,  $\frac{dU_2}{dx_2^d} = 0$  is

$$\frac{dU_2}{dx_2^d} = \frac{k_1 k_2 \alpha_{1x} (\frac{R_2}{p_y} - \frac{x_2^d (1+t_1)(1+t_2) \alpha_{1y}}{k_1 \alpha_{1x}} + l \alpha_{2y}) - k_2 \alpha_{1y} x_2^d (1+t_1)(1+t_2)}{k_1 (k_2 x_2^d)^{0.5} \alpha_{1x} (\frac{R_2}{p_y} - \frac{x_2^d (1+t_1)(1+t_2) \alpha_{1y}}{k_1 \alpha_{1x}} + l \alpha_{2y})^{0.5}} = 0 \quad (4.19h)$$

Validating at  $R_2 = t_2 p_x x_2^d$  and the corner equilibrium price  $p = \frac{p_x}{p_y} = \frac{(1+t_1) \alpha_{1y}}{k_1 \alpha_{1x}}$ , we

have

$$x_2^d = \frac{l k_1 \alpha_{1x} \alpha_{2y}}{(1+t_1)(2+t_2) \alpha_{1y}} \quad (4.19i)$$

Inserting the above equation into equation (4.19f), we have

$$y_2^s = \frac{\alpha_{2y} l}{2+t_2} \quad (4.19j)$$

Combining equation (4.19j) with equation (4.19b), we have

$$y_2 = \alpha_{2y} l \frac{1+t_2}{2+t_2} \quad (4.19k)$$

Substituting equations (4.19i) and (4.19k) into the utility function, we have

$$U_2 = \frac{\alpha_{2y} l}{2+t_2} \left( \frac{(1+t_2)k_1 k_2 \alpha_{1x}}{(1+t_1)\alpha_{1y}} \right)^{0.5} \quad (4.19l)$$

The market clearing condition for good  $x$  is

$$M_1 x_1^s = M_2 x_2^d \quad (4.19m)$$

Substituting the optimum corner solution of  $x_1^s$  and  $x_2^d$ , as shown in equations (4.18j) and (4.19i), we obtain the optimum amount of labor which an individual in the developed country allocates into production of good  $x$

$$l_{1x} = \frac{l}{2} + \frac{(2+t_1)k_1 M_2 \alpha_{2y} l}{2(1+t_1)(2+t_2)M_1 \alpha_{1y}} \quad (4.19n)$$

Structure CP

As in the free trade case, the corner equilibrium relative market price is determined by the developing country producing both goods  $x$  and  $y$  in structure CP. Within structure CP, an individual in the developing country chooses configuration  $(xy/x)_2$  and the decision problem can be described as follows

$$\underset{x_2, x_2^d, y_2, y_2^s, l_{2x}, l_{2y}}{Max}: U_2 = (x_2 + k_2 x_2^d)^{0.5} (y_2)^{0.5} \quad (4.20a)$$

$$\text{s.t. } x_2 = \alpha_{2x} l_{2x}, \quad y_2 + y_2^s = \alpha_{2y} l_{2y} \quad (4.20b)$$

$$R_2 + p_y y_2^s = (1+t_2) p_x x_2^d \quad (4.20c)$$

$$l_{2x} + l_{2y} = l \quad (4.20d)$$

$$R_2 = t_2 p_x x_2^d \quad (4.20e)$$

The corner equilibrium relative price is determined at

$$p = \frac{p_x}{p_y} = \frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}} \quad (4.20f)$$

From equation (4.20c) we have

$$x_2^d = \frac{R_2}{(1+t_2)p_x} + \frac{y_2^s}{(1+t_2)p} \quad (4.20g)$$

Substituting constraints (4.20b) and (4.20g) into equation (4.20a) to eliminate  $x_2, x_2^d, y_2, l_{2y}$ , we have the unconstrained utility maximization problem as

$$\underset{y_2^s, l_{2y}}{Max}: U_2 = (\alpha_{2x}(l - l_{2y}) + \frac{k_2 R_2}{(1+t_2)p_x} + \frac{k_2 y_2^s}{(1+t_2)p})^{0.5} (\alpha_{2y} l_{2y} - y_2^s)^{0.5} \quad (4.20h)$$

The first order condition with respect to  $y_2^s$  is

$$\frac{\partial U_2}{\partial y_2^s} = \frac{0.5 k_2 (\alpha_{2y} l_{2y} - y_2^s) - (1+t_2)p (\alpha_{2x}(l - l_{2y}) + \frac{k_2 R_2}{(1+t_2)p_x} + \frac{k_2 y_2^s}{(1+t_2)p})}{(1+t_2)p (\alpha_{2x}(l - l_{2y}) + \frac{k_2 R_2}{(1+t_2)p_x} + \frac{k_2 y_2^s}{(1+t_2)p})^{0.5} (\alpha_{2y} l_{2y} - y_2^s)^{0.5}} = 0 \quad (4.20i)$$

Validating (4.20i) at  $R_2 = t_2 p_x x_2^d$  and  $p = \frac{p_x}{p_y} = \frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}}$ , we have

$$y_2^s = \frac{(2l_{2y} - l) \alpha_{2y}}{2 + t_2} \quad (4.20j)$$

Substituting equations (4.20e) and (4.20j) into equation (4.20g), we have

$$x_2^d = \frac{(2l_{2y} - l)(1+t_2) \alpha_{2x}}{k_2 (2 + t_2)} \quad (4.20k)$$

Substitution of equation (4.20j) into equation (4.20b) yields

$$y_2 = \alpha_{2y} \frac{l + t_2 l_{2y}}{2 + t_2} \quad (4.20l)$$

Substituting equations (4.20j) to (4.20l) into utility function (4.20a), we have



$$U_2(xy/x) = \frac{l+t_2l_{2y}}{2+t_2}(\alpha_{2x}\alpha_{2y})^{0.5} \quad (4.20m)$$

Within market structure CP, an individual in the developed country chooses configuration  $(x/y)_1$  and the decision problem can be expressed as follows

$$\underset{x_1, x_1^s, y_1^d}{Max}: U_1 = (x_1)^{0.5} (k_1 y_1^d)^{0.5} \quad (4.21a)$$

$$s.t. \quad x_1 + x_1^s = \alpha_{1x}l \quad (4.21b)$$

$$(1+t_1)p_y y_1^d = p_x x_1^s + R_1 \quad (4.21c)$$

$$R_1 = t_1 p_y y_1^d \quad (4.21d)$$

The corner equilibrium relative price is determined by the developing country at

$$p = \frac{p_x}{p_y} = \frac{k_2 \alpha_{2y}}{(1+t_2)\alpha_{2x}} \quad (4.21e)$$

From equation (4.21c) we have

$$y_1^d = \frac{p x_1^s}{(1+t_1)} + \frac{R_1}{(1+t_1)p_y} \quad (4.21f)$$

Substituting equations (4.21b) and (4.21f) into equation (4.21a), we can convert the constrained utility maximization problem into an unconstrained utility maximization problem as

$$\underset{x_1^s}{Max}: U_1 = (\alpha_{1x}l - x_1^s)^{0.5} \left( \frac{k_1 p x_1^s}{(1+t_1)} + \frac{k_1 R_1}{(1+t_1)p_y} \right)^{0.5} \quad (4.21g)$$

The first order condition with respect to  $x_1^s$  of equation (4.21g) is

$$\frac{\partial U_1}{\partial x_1^s} = \frac{0.5 k_1 p (\alpha_{1x}l - x_1^s)^{0.5}}{(1+t_1) \left( \frac{k_1 p x_1^s}{(1+t_1)} + \frac{k_1 R_1}{(1+t_1)p_y} \right)^{0.5}} - \frac{0.5 \left( \frac{k_1 p x_1^s}{(1+t_1)} + \frac{k_1 R_1}{(1+t_1)p_y} \right)^{0.5}}{(\alpha_{1x}l - x_1^s)^{0.5}} = 0 \quad (4.21h)$$

Validating the above equation at  $R_1 = t_1 p_y y_1^d$  and  $p = \frac{p_x}{p_y} = \frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}}$ , we have

$$x_1^s = \frac{\alpha_{1x} l}{2+t_1} \quad (4.21i)$$

Inserting the above equation into equation (4.21b), we have

$$x_1 = \frac{(1+t_1) \alpha_{1x} l}{2+t_1} \quad (4.21j)$$

Substituting equations (4.21d) and (4.21j) into equation (4.21f), we have

$$y_1^d = \frac{\alpha_{1x} \alpha_{2y} k_2 l}{(2+t_1)(1+t_2) \alpha_{2x}} \quad (4.21k)$$

Substituting equations (4.21j) and (4.21k) into utility function (4.21a), we have

$$U_1(x/y) = \frac{\alpha_{1x} l}{2+t_1} \left( \frac{(1+t_1) \alpha_{2y} k_1 k_2}{(1+t_2) \alpha_{2x}} \right)^{0.5} \quad (4.21l)$$

The market clearing condition for good  $x$  is

$$M_1 x_1^s = M_2 x_2^d \quad (4.21m)$$

Substituting the optimum corner solution of  $x_1^s$  and  $x_2^d$ , as shown in (4.21i) and (4.20k), into equation (4.21m), we obtain the optimum amount of labor which an individual in the developing country allocates into production of good  $y$  as

$$l_{2y} = \frac{l}{2} + \frac{(2+t_2) M_1 \alpha_{1x} k_2 l}{2(2+t_1)(1+t_2) M_2 \alpha_{2x}} \quad (4.21n)$$

#### Structure CC

Within market structure CC, an individual in the developed country chooses configuration  $(x/y)_1$  and the decision problem can be expressed the same as in equations (4.21a) to (4.21d). Following the same procedure, we solve for the corner equilibrium supply and

demand functions of an individual in the developed country choosing configuration  $(x/y)_1$  as

$$x_1^s = \frac{\alpha_{1x}l}{2+t_1}, \quad x_1 = \frac{(1+t_1)\alpha_{1x}l}{2+t_1}, \quad y_1^d = \frac{p\alpha_{1x}l}{2+t_1} \quad (4.22a)$$

Within structure CC, an individual in the developing country choosing configuration  $(y/x)_2$  and the decision problem can be expressed the same as in equations (4.19a) to (4.19d).

Following the same procedure, we can solve for the corner equilibrium supply and demand functions of an individual in the developing country choosing configuration  $(y/x)_2$  as

$$y_2^s = \frac{\alpha_{2y}l}{2+t_2}, \quad y_2 = \frac{(1+t_2)\alpha_{2y}l}{2+t_2}, \quad x_2^d = \frac{\alpha_{2y}l}{(2+t_2)p} \quad (4.22b)$$

The market clearing condition for good  $x$  is

$$M_1x_1^s = M_2x_2^d \quad (4.22c)$$

Substituting the optimum corner solution of  $x_1^s$  and  $x_2^d$ , as shown in (4.22a) and (4.22b), into equation (4.9c), we obtain the corner equilibrium relative price under market structure as

$$p = \frac{(2+t_1)M_2\alpha_{2y}}{(2+t_2)M_1\alpha_{1x}} \quad (4.22d)$$

Plugging the corner equilibrium relative price into equation (4.22a) and (4.22b), we have

$$y_1^d = \frac{M_2\alpha_{2y}l}{(2+t_2)M_1} \quad (4.22e)$$

$$x_2^d = \frac{M_1\alpha_{1x}l}{(2+t_1)M_2} \quad (4.22f)$$

Substituting the corner equilibrium supply and demand functions into the utility functions for the representative individual in both countries (equations (4.21a) and (4.19a)), we have

$$U_1(x/y) = l \left( \frac{(1+t_1)k_1 M_2 \alpha_{1x} \alpha_{2y}}{(2+t_1)(2+t_2)M_1} \right)^{0.5} \quad (4.22g)$$

$$U_2(y/x) = l \left( \frac{(1+t_2)k_2 M_1 \alpha_{1x} \alpha_{2y}}{(2+t_1)(2+t_2)M_2} \right)^{0.5} \quad (4.22h)$$

We summarize our solutions to all four corner equilibriums in the Ricardian model in Table 4.3.

Table 4.3 shows that when a structure with partial division of labor (structure PC or CP) is the general equilibrium structure, the relative price is determined by the country producing both goods  $x$  and  $y$ . For instance, in market structure CP, the developing country (country 2) determines the relative price of  $P_x$  with respect to  $P_y$  as  $p = \frac{P_x}{P_y} = \frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}}$ . Since the developing country exports its comparatively advantaged good  $y$  and imports its comparatively disadvantaged good  $x$ , the terms of trade for the developing country ( $\frac{P_y}{P_x}$ ) will deteriorate as the trading efficiency ( $k_2$ ) increases, the relative productivity between two countries' comparatively advantaged goods ( $\frac{\alpha_{2y}}{\alpha_{2x}}$ ) increases, and the tariff rate decreases. The terms of trade for the developed country will move in the opposite direction responding to the same parameter changes in the developing country and will not respond to any change in its own economic system.

If the market structure with complete division of labor (structure CC) is the general equilibrium structure, the general equilibrium relative price is determined by both countries at

$p = \frac{p_x}{p_y} = \frac{(2+t_1)M_2 \alpha_{2y}}{(2+t_2)M_1 \alpha_{1x}}$ . The terms of trade for the developing country ( $\frac{P_y}{P_x}$ ) will improve as the

relative population size ( $\frac{M_2}{M_1}$ ) and the relative productivity of the comparatively advantaged sector ( $\frac{\alpha_{2y}}{\alpha_{1x}}$ ) decrease, the tariff rate in the developed country ( $t_1$ ) decreases and the tariff rate in the developing country ( $t_2$ ) increases.

However, deterioration in terms of trade of one country does not necessarily indicate welfare loss in that country. We can take the derivative of the utility functions with respect to the tariff rate from Table 4.3 and Table 4.4. Because the expressions of the derivatives are complex, we only report the signs of the derivatives in Table 4.5 and Table 4.6 showing the welfare impacts of tariff rate in both countries for  $\mu_i = 1$  and  $\mu_i = 0$ . For  $\mu_i = 1$ , our results indicate that individuals in the both countries obtain a higher utility level than they do in autarky if the general equilibrium occurs in a structure with some degree of division of labor (structures PC, CP or CC). Otherwise, individuals in both countries will choose the autarky configuration. When general equilibrium occurs at a structure with partial division of labor, the large country producing two goods can improve its residents' welfare by raising its tariff rate, which can be seen that  $\partial U_1 / \partial t_1 > 0$  in structure PC and  $\partial U_2 / \partial t_2 > 0$  in structure CP. This is because the large country can determine the terms of trade by changing its tariff rate. Thus, its share of gains from trade will increase if it increases its tariff rate. However, this increase in gains for the large country is at the expense of its trading partner because  $\partial U_2 / \partial t_1 < 0$  in structure PC and  $\partial U_1 / \partial t_2 < 0$  in structure CP. When the large country imposes a sufficiently high tariff, the small country may choose to withdraw from trade because gains from trade are overrun by losses from the tariff for the small country, in which case both countries get hurt.

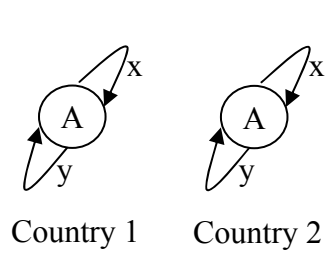
In contrast to the large country, the small country only hurts itself and its trading partner by imposing a tariff, which is shown in Table 4.5,  $\partial U_2/\partial t_2 < 0$  and  $\partial U_1/\partial t_2 < 0$  in structure PC and  $\partial U_1/\partial t_1 < 0$  and  $\partial U_2/\partial t_1 < 0$  in structure CP. This is because the small country has no influence on the terms of trade.

If the general equilibrium occurs in structure CC in which both countries can affect the terms of trade, both developed country and developing country will be better off by increasing their tariff rate given the tariff rate in trading-partner country, which can be seen that  $\partial U_1/\partial t_1 > 0$  and  $\partial U_2/\partial t_2 > 0$  in Table 4.5. But in each case the welfare increase is at the expense of the trading-partner, which can be seen that  $\partial U_2/\partial t_1 > 0$  and  $\partial U_1/\partial t_2 < 0$  in structure CC in Table 4.5. Both countries may be tempted to increase their tariff rate to improve their welfare. But if one country increases its tariff rate too high, its trading partner may withdraw from trade to autarky, in which case both countries get hurt.

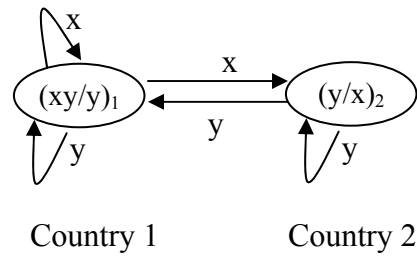
The story is different if the transfer efficiency of the tariff revenue equals zero ( $\mu_1 = \mu_2 = 0$ ). In this case, welfare of individuals in the large country are not affected by tariff rate changes in both countries,  $\partial U_1/\partial t_1 = 0$  and  $\partial U_1/\partial t_2 = 0$  in structure PC and  $\partial U_2/\partial t_1 = 0$  and  $\partial U_2/\partial t_2 = 0$  in structure CP in Table 4.6. As the tariff rate increase changes the relative price, individuals reallocate their production and consumption so that they can stay on the same indifference curve. Since the government in the large country reaps the tariff revenues, the large country has incentives to increase its tariff rate. However, this tariff rate increase will hurt residents in the small country,  $\partial U_2/\partial t_1 < 0$  in structure PC and  $\partial U_1/\partial t_2 < 0$  in structure CP in Table 4.6. Tariff rate increases in the small country will hurt its residents' welfare. Since the

government reaps tariff revenues, the small country may still have incentives to increase the tariff rate if the government weighs the tariff revenues more than its residents' welfare.

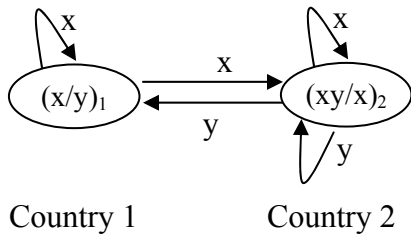
Table 4.3 also implies that as the transaction efficiency increases, the division of labor will increase and thus improve the welfare situation. Take structure CP as an instance, as the transaction efficiency in the developing country ( $k_2$ ) increases, the amount of labor allocated into its comparatively disadvantaged good  $x$  by the developing country ( $l_{2x}$ ) decreases and the amount of labor allocated into its comparatively advantage good  $y$  ( $l_{2y}$ ) increases. In other words, the degree of specialization and division of labor in the developing country's comparatively advantaged good  $y$  increases. As a result of this increased specialization, welfare increases. We find that gains from increased division of labor to individuals hinges on the transfer efficiency of tariff revenues. As shown in Table 4.4, individuals in the developing country within structure CP do not receive any gain from increased degree of division of labor (increased  $l_{2y}$ ) if the transfer efficiency of tariff revenues equals zero.



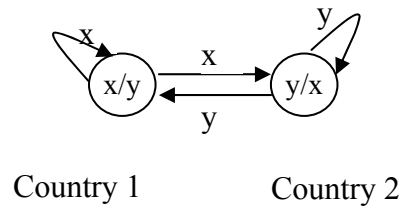
(1) Structure AA



(2) Structure PC



(3) Structure CP



(4) Structure CC

Figure 4.1: Configurations and Structures



Table 4.1: Four Corner Equilibria in the Ricardian Model

Structure	Relative Price	Developed Country	Developing Country
AA	n.a.	$x_1 = \frac{1}{2}\alpha_{1x}l, \quad y_1 = \frac{1}{2}\alpha_{1y}l$ $U_1(A) = \frac{1}{2}\alpha_{1x}^{0.5}\alpha_{1y}^{0.5}l$	$x_2 = \frac{1}{2}\alpha_{2x}l, \quad y_2 = \frac{1}{2}\alpha_{2y}l$ $U_2(A) = \frac{1}{2}\alpha_{2x}^{0.5}\alpha_{2y}^{0.5}l$
PC	$p = \frac{\alpha_{1y}}{k_1\alpha_{1x}}$	$x_1 = \frac{1}{2}\alpha_{1x}l, \quad x_1^s = \alpha_{1x}(l_{1x} - \frac{l}{2})$ $y_1 = \alpha_{1y}(l - l_{1x}),$ $y_1^d = \frac{\alpha_{1y}}{k_1}(l_{1x} - \frac{l}{2})$ $U_1 = U_1(A) = \frac{1}{2}\alpha_{1x}^{0.5}\alpha_{1y}^{0.5}l$ $l_{1x} = \frac{l}{2} + \frac{k_1M_2\alpha_{2y}}{2M_1\alpha_{1y}}l$	$x_2^d = \frac{\alpha_{1x}\alpha_{2y}k_1l}{2\alpha_{1y}},$ $y_2^s = y_2 = \frac{1}{2}\alpha_{2y}l$ $U_2 = \frac{1}{2}\alpha_{2y}l(\frac{\alpha_{1x}k_1k_2}{\alpha_{1y}})^{0.5}$
CP	$p = \frac{k_2\alpha_{2y}}{\alpha_{2x}}$	$x_1 = x_1^s = \frac{1}{2}\alpha_{1x}l, \quad y_1^d = \frac{\alpha_{1x}\alpha_{2y}k_2l}{2\alpha_{2x}}$ $U_1 = \frac{1}{2}\alpha_{1x}l(\frac{\alpha_{2y}k_1k_2}{\alpha_{2x}})^{0.5}$	$x_2 = \alpha_{2x}(l - l_{2y}),$ $x_2^d = \frac{\alpha_{2x}(2l_{2y} - l)}{2k_2}$ $y_2 = \frac{1}{2}\alpha_{2y}l, \quad y_2^s = \alpha_{2y}(l_{2y} - \frac{1}{2}l)$ $U_2 = U_2(A) = \frac{l}{2}\alpha_{2x}^{0.5}\alpha_{2y}^{0.5}$ $l_{2y} = \frac{l}{2} + \frac{M_1\alpha_{1x}k_2l}{2M_2\alpha_{2x}}$
CC	$p = \frac{M_2\alpha_{2y}}{M_1\alpha_{1x}}$	$x_1 = x_1^s = \frac{1}{2}\alpha_{1x}l, \quad y_1^d = \frac{M_2}{2M_1}\alpha_{2y}l$ $U_1 = \frac{l}{2}(\frac{k_1M_2\alpha_{1x}\alpha_{2y}}{M_1})^{0.5}$	$x_2^d = \frac{M_1}{2M_2}\alpha_{1x}l, \quad y_2 = y_2^s = \frac{1}{2}\alpha_{2y}l$ $U_2 = \frac{l}{2}(\frac{M_1k_2\alpha_{1x}\alpha_{2y}}{M_2})^{0.5}$

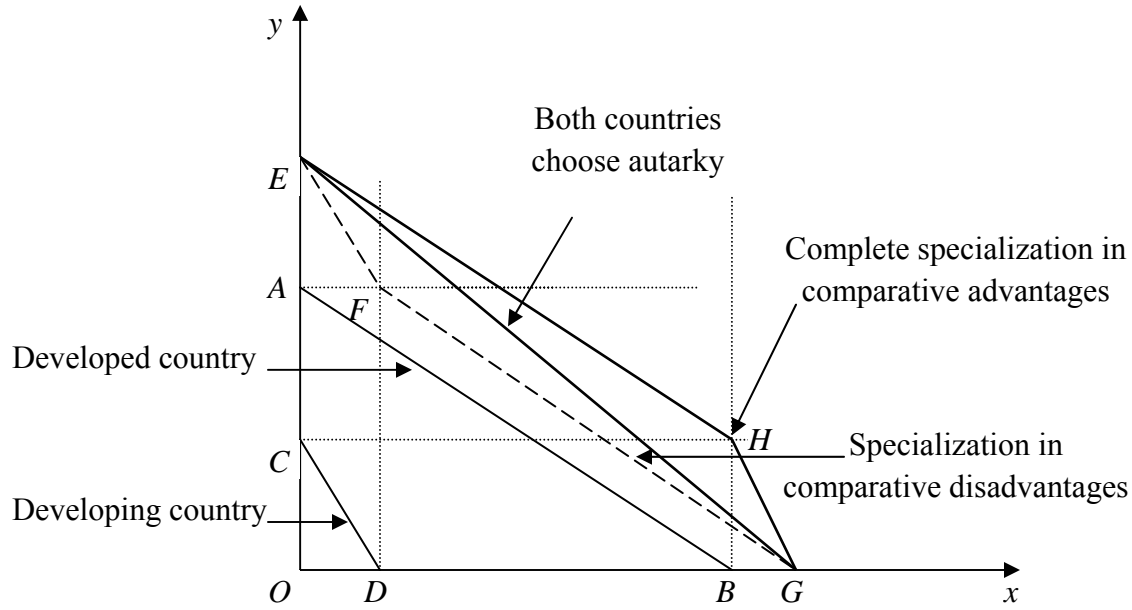


Figure 4.2: Economies of division of labor based on exogenous technical advantages

Table 4.2: Parameter Subspace for Each Market Structure

Parameter Subspace		$k_1 > \frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}, k_2 > \frac{\alpha_{2x}\alpha_{1y}}{\alpha_{1x}\alpha_{2y}}$		
		$k_2 < k_1 < \frac{M_1\alpha_{1y}}{M_2\alpha_{2y}}$ $\frac{M_1}{M_2} > \frac{\alpha_{2x}}{\alpha_{1x}}$	$k_1 > \frac{M_1\alpha_{1y}}{M_2\alpha_{2y}}$ $k_2 < \frac{M_2\alpha_{2x}}{M_1\alpha_{1x}}$ $\frac{M_1}{M_2} < \frac{\alpha_{2y}}{\alpha_{1y}} < 1$	$k_1 > \frac{M_1\alpha_{1y}}{M_2\alpha_{2y}}, k_2 > \frac{M_2\alpha_{2x}}{M_1\alpha_{1x}}$ $\frac{\alpha_{2x}}{\alpha_{1x}} < \frac{M_1}{M_2} < \frac{\alpha_{2y}}{\alpha_{1y}} < 1$
General Equilibrium	AA	PC	CP	CC

Table 4.3: Four Corner Equilibria in the Ricardian Model: With Tariff and  $\mu_i = 1$

Structure	Relative Price	Developed Country	Developing Country
AA	n.a.	$x_1 = \frac{1}{2} \alpha_{1x} l, \quad y_1 = \frac{1}{2} \alpha_{1y} l$ $U_1(A) = \frac{1}{2} \alpha_{1x}^{0.5} \alpha_{1y}^{0.5} l$	$x_2 = \frac{1}{2} \alpha_{2x} l, \quad y_2 = \frac{1}{2} \alpha_{2y} l$ $U_2(A) = \frac{1}{2} \alpha_{2x}^{0.5} \alpha_{2y}^{0.5} l$
PC	$\frac{(1+t_1)\alpha_{1y}}{k_1\alpha_{1x}}$	$x_1 = \alpha_{1x} \frac{l+t_1 l_{1x}}{2+t_1}, \quad x_1^s = \frac{\alpha_{1x}(2l_{1x}-l)}{2+t_1}$ $y_1 = \alpha_{1y}(l-l_{1x}), \quad y_1^d = \frac{(1+t_1)(2l_{1x}-l)\alpha_{1y}}{(2+t_1)k_1}$ $U_1(xy/y) = \frac{l+t_1 l_{1x}}{2+t_1} (\alpha_{1x} \alpha_{1y})^{0.5}$ $l_{1x} = \frac{l}{2} + \frac{(2+t_1)k_1 M_2 \alpha_{2y} l}{2(1+t_1)(2+t_2)M_1 \alpha_{1y}}$	$x_2^d = \frac{lk_1 \alpha_{1x} \alpha_{2y}}{(1+t_1)(2+t_2)\alpha_{1y}},$ $y_2 = \alpha_{2y} l \frac{1+t_2}{2+t_2}, \quad y_2^s = \frac{\alpha_{2y} l}{2+t_2}$ $U_2 = \frac{\alpha_{2y} l}{2+t_2} \left( \frac{(1+t_2)k_1 k_2 \alpha_{1x}}{(1+t_1)\alpha_{1y}} \right)^{0.5}$

Table 4.3: Four Corner Equilibria in the Ricardian Model: With Tariff and  $\mu_i = 1$  (continued)

CP	$\frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}}$	$x_1^s = \frac{(1+t_1) \alpha_{1x} l}{2+t_1}, \quad x_1^s = \frac{\alpha_{1x} l}{2+t_1}$ $y_1^d = \frac{\alpha_{1x} \alpha_{2y} k_2 l}{(2+t_1)(1+t_2) \alpha_{2x}}$ $U_1(x/y) = \frac{\alpha_{1x} l}{2+t_1} \left( \frac{(1+t_1) \alpha_{2y} k_1 k_2}{(1+t_2) \alpha_{2x}} \right)^{0.5}$	$x_2^d = \frac{(2l_{2y} - l)(1+t_2) \alpha_{2x}}{k_2(2+t_2)}$ $y_2 = \alpha_{2y} \frac{l+t_2 l_{2y}}{2+t_2}, \quad y_2^s = \frac{(2l_{2y} - l) \alpha_{2y}}{2+t_2}$ $U_2(xy/x) = \frac{l+t_2 l_{2y}}{2+t_2} (\alpha_{2x} \alpha_{2y})^{0.5}$ $l_{2y} = \frac{l}{2} + \frac{(2+t_2) M_1 \alpha_{1x} k_2 l}{2(2+t_1)(1+t_2) M_2 \alpha_{2x}}$
CC	$\frac{(2+t_1) M_2 \alpha_{2y}}{(2+t_2) M_1 \alpha_{1x}}$	$x_1^s = \frac{(1+t_1) \alpha_{1x} l}{2+t_1}, \quad x_1^s = \frac{\alpha_{1x} l}{2+t_1}$ $y_1^d = \frac{M_2 \alpha_{2y} l}{(2+t_2) M_1}$ $U_1(x/y) = l \left( \frac{(1+t_1) k_1 M_2 \alpha_{1x} \alpha_{2y}}{(2+t_1)(2+t_2) M_1} \right)^{0.5}$	$x_2^d = \frac{M_1 \alpha_{1x} l}{(2+t_1) M_2},$ $y_2 = \frac{(1+t_2) \alpha_{2y} l}{2+t_2}, \quad y_2^s = \frac{\alpha_{2y} l}{2+t_2}$ $U_2(y/x) = l \left( \frac{(1+t_2) k_2 M_1 \alpha_{1x} \alpha_{2y}}{(2+t_1)(2+t_2) M_2} \right)^{0.5}$

Table 4.4: Four Corner Equilibriums in the Ricardian Model: With Tariff and  $\mu_i = 0$

Structure	Relative Price	Developed Country	Developing Country
AA	n.a.	$x_1 = \frac{1}{2} \alpha_{1x} l, \quad y_1 = \frac{1}{2} \alpha_{1y} l$ $U_1(A) = \frac{1}{2} \alpha_{1x}^{0.5} \alpha_{1y}^{0.5} l$	$x_2 = \frac{1}{2} \alpha_{2x} l, \quad y_2 = \frac{1}{2} \alpha_{2y} l$ $U_2(A) = \frac{1}{2} \alpha_{2x}^{0.5} \alpha_{2y}^{0.5} l$
PC	$\frac{(1+t_1)\alpha_{1y}}{k_1\alpha_{1x}}$	$x_1 = \frac{\alpha_{1x} l}{2}, \quad x_1^s = \frac{\alpha_{1x} (2l_{1x} - l)}{2}$ $y_1 = \alpha_{1y} (l - l_{1x}), \quad y_1^d = \frac{(2l_{1x} - l)\alpha_{1y}}{2k_1}$ $U_1(xy/y) = \frac{l}{2} (\alpha_{1x} \alpha_{1y})^{0.5}$ $l_{1x} = \frac{l}{2} + \frac{k_1 M_2 \alpha_{2y} l}{2(1+t_1)(1+t_2)M_1 \alpha_{1y}}$	$x_2^d = \frac{lk_1 \alpha_{1x} \alpha_{2y}}{2(1+t_1)(1+t_2)\alpha_{1y}},$ $y_2 = y_2^s = \frac{\alpha_{2y} l}{2}$ $U_2 = \frac{\alpha_{2y} l}{2} \left( \frac{k_1 k_2 \alpha_{1x}}{(1+t_1)(1+t_2)\alpha_{1y}} \right)^{0.5}$

Table 4.4: Four Corner Equilibria in the Ricardian Model: With Tariff and  $\mu_i = 0$  (continued)

CP	$\frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}}$	$x_1^s = x_1^d = \frac{\alpha_{1x} l}{2}$ $y_1^d = \frac{\alpha_{1x} \alpha_{2y} k_2 l}{2(1+t_1)(1+t_2) \alpha_{2x}}$ $U_1(x/y) = \frac{\alpha_{1x} l}{2} \left( \frac{k_1 k_2 \alpha_{2y}}{(1+t_1)(1+t_2) \alpha_{2x}} \right)^{0.5}$	$x_2 = \alpha_{2x}(l - l_{2y}), \quad x_2^d = \frac{(2l_{2y} - l) \alpha_{2x}}{2k_2}$ $y_2 = \frac{\alpha_{2y} l}{2}, \quad y_2^s = \frac{(2l_{2y} - l) \alpha_{2y}}{2}$ $U_2(xy/x) = \frac{l}{2} (\alpha_{2x} \alpha_{2y})^{0.5}$ $l_{2y} = \frac{l}{2} + \frac{M_1 \alpha_{1x} k_2 l}{2M_2 \alpha_{2x}}$
CC	$\frac{M_2 \alpha_{2y}}{(1+t_2) M_1 \alpha_{1x}}$	$x_1^s = x_1^d = \frac{\alpha_{1x} l}{2}$ $y_1^d = \frac{M_2 \alpha_{2y} l}{2(1+t_1)(1+t_2) M_1}$ $U_1(x/y) = \frac{l}{2} \left( \frac{k_1 M_2 \alpha_{1x} \alpha_{2y}}{(1+t_1)(1+t_2) M_1} \right)^{0.5}$	$x_2^d = \frac{M_1 \alpha_{1x} l}{2M_2}$ $y_2 = y_2^s = \frac{\alpha_{2y} l}{2}$ $U_2(y/x) = \frac{l}{2} \left( \frac{k_2 M_1 \alpha_{1x} \alpha_{2y}}{M_2} \right)^{0.5}$

Table 4.5: Per Capita Real Income Change in the 2X2 Ricardian Model:  $\mu_i = 1$

Structure	The Developed Country		The Developing country	
	$\partial U_1 / \partial t_1$	$\partial U_1 / \partial t_2$	$\partial U_2 / \partial t_1$	$\partial U_2 / \partial t_2$
PC	+	-	-	-
CP	-	-	-	+
CC	+	-	-	+

Table 4.6: Per Capita Real Income Change in the 2X2 Ricardian Model:  $\mu_i = 0$

Structure	The Developed Country		The Developing country	
	$\partial U_1 / \partial t_1$	$\partial U_1 / \partial t_2$	$\partial U_2 / \partial t_1$	$\partial U_2 / \partial t_2$
PC	0	0	-	-
CP	-	-	0	0
CC	-	-	0	0

## **CHAPTER FIVE**

### **EXTENDED 3X2 NEW CLASSICAL TRADE-POVERTY MODEL**

In chapter four we analyzed the equilibrium structures and the welfare implications on the developing country in a 2X2 new classical Ricardian model. The impacts on the poor developing country can be considered as the poverty impacts of trade liberalization. However, as mentioned in chapters two and three, the poor in the developing country are often concentrated in remote and poor inland areas. The poor inland region may be far from being integrated with the rich coastal region. Thus, the welfare benefits from trade liberalization on the whole developing country may not necessarily be transmitted to the poverty region, where most poor population clusters.

The coexistence of the poor inland region and rich coastal region in a developing country is parallel to the dual economy model developed by Lewis (1954), Ranis and Fei (1961) and others. Lewis's dual economy model considers an ongoing move of labor and resources from a "traditional sector" to a "modern sector" critical to the economic development. Ongoing capital accumulation in the modern sector continuously provides incentives for the labor and resources movement. Expanding the labels traditional sector and modern sector to poor inland region and rich coastal region in the developing country, we extend our new classical trade-poverty model from a 2X2 two-country case to a 3X2 case. However, we focus the incentives for resource movements between regions on evolution of division of labor due to international trade rather than capital accumulation in the modern sector.



### 5.1 Extended 3X2 New Classical Trade-Poverty Model

Suppose that a developed country ( $i = 1$ ) has trade relationship with a developing country which is segregated into two regions—a rich coastal region ( $i = 2$ ) and a poor inland region ( $i = 3$ ). The production functions in region  $i$  ( $i = 1, 2, 3$ ) are assumed to be the same as specified in equation (4.2a) and that  $\alpha_{1x} > \alpha_{2x} > \alpha_{3x}$ ,  $\alpha_{1y} > \alpha_{2y} > \alpha_{3y}$ ,  $\frac{\alpha_{1x}}{\alpha_{1y}} > \frac{\alpha_{2x}}{\alpha_{2y}} > \frac{\alpha_{3x}}{\alpha_{3y}}$ , i.e., the developed country ( $i = 1$ ) has absolute advantages in producing both goods  $x$  and  $y$  and a comparative advantage in producing good  $x$  to the two regions in the developing country ( $i = 2, 3$ ); the rich coastal region ( $i = 2$ ) has absolute advantages in producing both goods  $x$  and  $y$  and a comparative advantage in producing good  $x$  to the poor inland region ( $i = 3$ ) and a comparative advantage in producing good  $y$  to the developed country ( $i = 1$ ); the poor inland region in the developing country has a comparative advantage in producing good  $y$  relative to the developed country and the rich coastal region in the developing country. The transaction efficiency is assumed to have a pattern as  $k_1 > k_2 > k_3$ .

If we view the poor inland region just as another independent country, the model is similar to the 3X2 Ricardian model with three countries and two goods developed by Yang (2001). With an assumption of the same transaction efficiency in all countries, Yang proved that it was possible that country 2 (same as the rich coastal region in our poverty model) would be excluded from trade within a certain parameter subspace. However, in our trade-poverty model, we assume that the poor inland region does not trade directly with foreign exporters but indirectly participates in international trade through the rich coastal region. This is a reasonable

assumption because the poor inland region usually has insufficient physical capital stocks, human capital resources, and infrastructure facilities (such as transportation and information technologies), which are necessary to the success of international trade. Thus, the rich coastal region plays a very important role in facilitating the trade relationship between the developed country and the poor inland region, rather than being excluded from trade.

In general equilibrium a region will not specialize in producing its disadvantaged good. Thus, the developed country will choose only from three possible configurations: (A),  $(x/y)_1$  and  $(xy/y)_1$ . The coastal region in the developing country will choose from five possible configurations: (A),  $(y/x)_2$  and  $(xy/x)_2$ ,  $(x/y)_2$  and  $(xy/y)_2$ . The poor inland region in the developing country will choose from three possible configurations: (A),  $(y/x)_3$  and  $(xy/x)_3$ .

If the developing country takes a close-door trade policy, or imposes high enough trade barriers (including tariff and non-tariff trade barriers), the developed country may be excluded from international trade. The trade pattern is then reduced to domestic trade only and the equilibrium structures can be described by Figure 5.1. As shown in Figure 5.1, The trade pattern in equilibrium is similar to the two-country case in Figure 4.1 plus the developed country in autarky situation. Thereby we can apply the 2X2 new classical trade-poverty model established in chapter four to analyze how interregional (rather than international) trade policy and transfer payments within the developing country affect the poor.

If the developing country takes a free trade policy, the poor inland region may be excluded from trade due to its higher transaction cost compared to the rich coastal region. The trade pattern can also be reduced to a two-country case; the equilibrium structures are described

of by Figure 5.2. Trade liberalization will only affect welfare of residents in the coastal region in the developing country, while leaving the poor inland region in autarky.

If the poor inland region participates in trade under an open-door trade policy, the poor inland region in the developing country may not be able to satisfy the demand of good  $y$  in the developed country and the coastal region in the developing country, due to the low productivity in the poor inland region. The rich coastal region in the developing country also needs to supply good  $y$  to the developed country. Figure 5.3 illustrates the other three possible equilibrium structures in addition to the structures listed in Figure 5.1 and Figure 5.2.

Suppose all three regions participate in international trade and region  $i$  ( $i = 1, 2, 3$ ) imposes an *ad valorem* tariff  $t_i$  on the imported good and then transfers tariff revenues evenly to all residents in country  $i$ . Both regions in the developing country have the same tariff rate, that is,  $t_3 = t_2$ . The transfer efficiency in each region is assumed to be  $\mu_i$  ( $i = 1, 2, 3$ ). We only need to solve for the general equilibrium structures listed in Figure 5.3. We can follow the same procedure as used in chapter 4 to solve for the general equilibrium. To avoid unnecessary repetition, we only show the calculation about the poor inland region. The presented calculation below is for  $\mu_1 = \mu_2 = \mu_3 = 1$ .

#### Structure PCC

Individuals in the coastal region of the developing country choose configuration  $(y/x)$  in structure PCC and their decision problem is

$$\text{Max}_{y_3, y_3^d, x_3^d}: U_3 = (k_3 x_3^d)^{0.5} (y_3)^{0.5} \quad (5.1a)$$

$$\text{s.t. } y_3 + y_3^s = \alpha_{3y}l \quad (5.1b)$$

$$p_y y_3^s + R_3 = (1 + t_2) p_x x_3^d / k_2 \quad (5.1c)$$

We use  $x_3^d$  to denote the direct demand for good  $x$  from the coastal region and  $x_3^d / k_2$  the ultimate demand for good  $x$  of the inland region from the developed country. The transfer payment of tariff revenues is expressed as

$$R_3 = \mu_3 t_2 p_x x_3^d / k_2 \quad (5.1d)$$

The equilibrium relative price is determined as

$$p = \frac{p_x}{p_y} = \frac{(1 + t_1) \alpha_{1y}}{k_1 \alpha_{1x}} \quad (5.1e)$$

From equation (5.1c), we can have

$$y_3^s = (1 + t_2) p x_3^d / k_2 - \frac{R_3}{p_y} \quad (5.1f)$$

Substituting equations (5.1b) and (5.1f) into utility function (5.1a), we have

$$\text{Max}_{x_3^d} : U_3 = (k_3 x_3^d)^{0.5} (\alpha_{3y} l - (1 + t_2) p x_3^d / k_2 + \frac{R_3}{p_y})^{0.5} \quad (5.1g)$$

The first order condition with respect to  $x_3^d$ ,  $\frac{\partial U_3}{\partial x_3^d} = 0$  is

$$\frac{\partial U_3}{\partial x_3^d} = \frac{-0.5 k_3 x_3^d (1 + t_2) p / k_2 + 0.5 k_3 (\alpha_{3y} l - (1 + t_2) p x_3^d / k_2 + \frac{R_3}{p_y})}{(k_3 x_3^d)^{0.5} (\alpha_{3y} l - (1 + t_2) p x_3^d / k_2 + \frac{R_3}{p_y})^{0.5}} = 0 \quad (5.1h)$$

Validating at  $R_3 = \mu_3 t_2 p_x x_3^d / k_2$  and  $p = \frac{p_x}{p_y} = \frac{(1 + t_1) \alpha_{1y}}{k_1 \alpha_{1x}}$ , we have

$$x_3^d = \frac{l k_1 k_2 \alpha_{1x} \alpha_{3y}}{(1 + t_1)(2 + t_2) \alpha_{1y}} \quad (5.1i)$$

Inserting equations (5.1d) and (5.1i) into equation (5.1f), we have

$$y_3^s = \frac{\alpha_{3y}l}{2+t_2} \quad (5.1j)$$

Combining with equation (5.1b), we know that

$$y_3 = \frac{(1+t_2)\alpha_{3y}l}{2+t_2} \quad (5.1k)$$

Substituting equations (5.1i) and (5.1k) into the utility function, we solve for an individual's utility function in the poor inland region as

$$U_3(y/x) = \frac{\alpha_{3y}l}{2+t_2} \left( \frac{(1+t_2)k_1k_2k_3\alpha_{1x}}{(1+t_1)\alpha_{1y}} \right)^{0.5} \quad (5.1l)$$

We standardize the population of the developing country at one and assume the population of the rich coastal region is  $M_2$  and the population of the poor inland region  $(1-M_2)$ . Exports of good  $x$  of the developed country equal the imports of good  $x$  of the developing country. All the imports of the developing country are conducted through the coastal region. However, in terms of the origin of the demand,  $M_2 \cdot x_2^d$  is from the coastal region and  $(1-M_2) \cdot x_3^d / k_2$  from the inland region. The market clearing condition for good  $x$  is then as follows

$$M_1 \cdot x_1^s = M_2 \cdot x_2^d + (1-M_2) \cdot x_3^d / k_2 \quad (5.1m)$$

We can solve for the optimum labor allocation  $l_{1x}$  as

$$l_{1x} = \frac{l}{2} + \frac{(2+t_1)lk_1(M_2\alpha_{2y} + (1-M_2)\alpha_{3y})}{2(1+t_1)(2+t_2)M_1\alpha_{1y}} \quad (5.1n)$$

### Structure CPC

An individual in the poor inland region in structure CPC has the same decision problem

as in structure PCC. Following the same procedure except validating the corner equilibrium

relative price at  $p = \frac{p_x}{p_y} = \frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}}$ , we have the corner solution as

$$x_3^d = \frac{(1+t_2) l \alpha_{2x} \alpha_{3y}}{(2+t_2) \alpha_{2y}} \quad (5.2a)$$

$$y_3^s = \frac{\alpha_{3y} l}{2+t_2} \quad (5.2b)$$

$$y_3 = \frac{(1+t_2) \alpha_{3y} l}{2+t_2} \quad (5.2c)$$

$$U_3(y/x) = \frac{(1+t_2) \alpha_{3y} l}{2+t_2} \left( \frac{k_3 \alpha_{2x}}{(1+t_1) \alpha_{2y}} \right)^{0.5} \quad (5.2d)$$

$$p = \frac{p_x}{p_y} = \frac{k_2 \alpha_{2y}}{(1+t_2) \alpha_{2x}} \quad (5.2e)$$

### Structure CCC

An individual in the inland region has the same decision problem in structure CCC as in other structures. Following the same procedure but only validating at  $R_3 = \mu_3 t_2 p_x x_3^d / k_2$ , we thereby have

$$x_3^d = \frac{l k_2 \alpha_{3y}}{(2+t_2) p} \quad (5.3a)$$

$$y_3^s = \frac{\alpha_{3y} l}{2+t_2} \quad (5.3b)$$

$$y_3 = \frac{(1+t_2) \alpha_{3y} l}{2+t_2} \quad (5.3c)$$

$$p = \frac{(2+t_1)(M_2 \alpha_{2y} + (1-M_2) \alpha_{3y})}{(2+t_2) M_1 \alpha_{1x}} \quad (5.3d)$$

$$U_3(y/x) = \alpha_{3y} I \left( \frac{(1+t_2)M_1\alpha_{1x}k_2k_3}{(2+t_1)(2+t_2)(M_2\alpha_{2y} + (1-M_2)\alpha_{3y})} \right)^{0.5} \quad (5.3e)$$

Table 5.1 and Table 5.2 provide a summary on these three corner solutions for  $\mu_1 = \mu_2 = \mu_3 = 1$  and  $\mu_1 = \mu_2 = \mu_3 = 0$ , respectively.

## 5.2. General Equilibrium Analysis

We focus our attention on the welfare changes in the poor developing country, especially the poor inland region in the developing country. Before the developing country takes an open-door policy or trade liberalization policy, the initial general equilibrium structure is one of structures (AAA, APC, ACP and ACC) listed in Figure 5.1. The transaction efficiency for the poor inland region participating in domestic trade with the coastal region is  $k_3$ . After trade liberalization, the poor inland region participates in international trade through the coastal region and the transaction efficiency decreases to  $k_2k_3$ <sup>1</sup>. This is because the poor inland region faces a higher transaction cost in international trade than in domestic trade. Once the transaction efficiency ( $k_2k_3$ ) is less than a threshold in which the utility level of individuals in the inland region participating in international trade is lower than that choosing autarky, the general equilibrium structure may discontinuously switch from the initial general equilibrium structure to one of the structures (PCA, CPA and CCA) listed in Figure 5.2 and the poor inland region

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<sup>1</sup> The poor inland region faces greater transaction costs and lower transaction efficiency in international trade. For every one unit of good  $x$  imported from the developed country, the coast region can only re-exports  $k_2$  unit of the import to the inland region due to transaction costs. The inland region will be able to receive and consume only  $k_3$  percent of the  $k_2$  unit of imports. Thus, the inland region faces transaction efficiency at  $k_2k_3$  in international trade.

participates a lower level of division of labor. Consequentially, the poor inland region suffers from trade liberalization in the developing country. If the general equilibrium occurs in structure PCC (CPC or CCC), individuals in the poor inland region participate in the division of labor and receive higher utility than they do in autarky. Otherwise, individuals will withdraw from international trade and choose autarky.

Marginal comparative statics of our model show again that the deterioration of terms of trade does not necessarily lead to the welfare decrease. Suppose that the general equilibrium structure occurs in structure PCC where  $\mu_1 = \mu_2 = \mu_3 = 1$ . Table 5.1 shows that as the transaction efficiency in the developed country ( $k_1$ ) is improved, the relative price of good  $x$  to good  $y$

( $p = \frac{p_x}{p_y} = \frac{(1+t_1)\alpha_{1y}}{k_1\alpha_{1x}}$ ) decreases. The terms of trade of the developed country is deteriorated.

However, gains from trade of the developed country increase. The developing country exports good  $y$  and imports good  $x$  and the terms of trade for the developing country is

$\frac{1}{p} = \frac{p_y}{p_x} = \frac{k_1\alpha_{1x}}{(1+t_1)\alpha_{1y}}$  and thereby improved. We find that utilities of individuals in both regions

in the developing country ( $U_2$  and  $U_3$ ) are improved and thus gains from trade of the developing country increase. The gains from trade of both countries increase, but terms of trade deteriorate for the developed country and improve for the developing country.

Consider that the general equilibrium occurs in structure CPC as in Table 5.1. The coastal region in the developing country exports good  $y$  and imports good  $x$  at a relative price

$\frac{p_y}{p_x} = \frac{1}{p} = \frac{(1+t_2)\alpha_{2x}}{k_2\alpha_{2y}}$ . Assuming now that the transaction efficiency in the coastal region in the



developing country ( $k_2$ ) is improved, the terms of trade for the coastal region in the developing country thereby deteriorate. Individuals in the coastal region in the developing country will decrease the amount of labor allocated to produce good  $x$  ( $l_{2x}$ ) and thus the utility level of individuals in this region ( $U_2$ ) will increase. Meanwhile, the utility level of individuals in the poor inland region ( $U_3$ ) will remain the same as the transaction efficiency in the coastal region ( $k_2$ ) increases and the terms of trade decrease. As a whole, the developing country benefits from transaction efficiency improvement even though the term of trade of the country is deteriorated. Thus, our general equilibrium model does not support the common wisdom that the gains from trade of a country will fall as terms of trade of this country deteriorate.

Suppose that productivity of good  $y$  in the rich coastal region in the developing country ( $\alpha_{2y}$ ) is improved. Again in the general equilibrium structure CPC, the terms of trade for the developing country ( $\frac{p_y}{p_x} = \frac{1}{p} = \frac{(1+t_2)\alpha_{2x}}{k_2\alpha_{2y}}$ ) is deteriorated as the productivity of good  $y$  ( $\alpha_{2y}$ ) is improved. However, we observe that utility of individuals in the rich coastal region in the developing country ( $U_2$ ) increases and meanwhile utility of individuals in the poor inland region ( $U_3$ ) decreases. Terms of trade change have different impacts on different groups of individuals in the developing country. It is possible that some groups may receive gains from trade while others within the same country get hurt as terms of trade deteriorate.

Table 5.3 shows the welfare impacts of technology progress on the poor inland region in the developing country. If structure PCC occurs in the general equilibrium, the utility of individuals in the inland region is positively related to the relative productivity between its

comparatively advantaged good and comparatively disadvantaged good in the developed country ( $\frac{\alpha_{1x}}{\alpha_{1y}}$ ). The terms of trade are affected by this relative productivity. Because export and import structure in the developed country is complementary to that in the developing country, the increase of this relative productivity induces an increase of import demand of good  $y$  from the developing country. The inland region thereby has an opportunity to export more good  $y$  to the developed country at a higher relative price of  $\frac{p_y}{p_x} = \frac{1}{p} = \frac{(1+t_2)\alpha_{2x}}{k_2\alpha_{2y}}$ . If structure CPC occurs in the general equilibrium, the utility of individuals in the inland region is negatively related to the relative productivity between its comparatively advantaged good and comparatively disadvantaged good in the coastal region of the developing country ( $\frac{\alpha_{2y}}{\alpha_{2x}}$ ). This is because that export and import structure in coastal region in the developing country is competitory to that in the inland region. The increase of this relative productivity induces an increase of import demand of good  $y$  from the coastal region in the developing country but a decrease of import demand from the inland region. The technology progress of its comparatively advantaged good  $y$  in the inland region (an increase of  $\alpha_{3y}$ ) is found to contribute to the welfare improvement in all possible equilibrium structures ( $\frac{\partial U_3}{\partial \alpha_{3y}}$ ). Thus, the nature of technology progress (complementary or competitory to that in the inland region) has important impacts on the welfare of individuals in the inland region.

Table 5.4 reports the impacts of tariff reduction on per capital real income (utility) in both countries. Results in Table 5.4 show that if the general equilibrium occurs in structure PCC, the

developed country can increase its own welfare by increasing its tariff rate given the tariff rate in the developing country since  $\frac{dU_1}{dt_1} > 0$ . But the welfare gain to the developed country is at the

expense of the developing country since  $\frac{dU_2}{dt_1} < 0$  and  $\frac{dU_3}{dt_1} < 0$  in structure PCC in Table 5.4.

If the general equilibrium occurs in structure CPC, both coastal region and inland region in the developing country will gain from the tariff increase given the tariff rate in the developed country,

which can be seen that  $\frac{dU_2}{dt_2} > 0$ ,  $\frac{dU_3}{dt_2} > 0$  and  $\frac{dU_1}{dt_2} < 0$  in structure PCC in Table 5.4. This is

because the “large country” (the developed country in PCC and the coastal region in the developing country in CPC) determines the terms of trade, and thereby this country can improve its terms of trade by imposing a tariff and thus obtain a larger share of the gains from trade.

In contrast to the large country, the small country (the developing country in structure PCC and the developed country in structure CPC) will get worse off if the government chooses to increase its tariff rate, which can be seen that  $\frac{dU_2}{dt_2} < 0$  and  $\frac{dU_3}{dt_2} < 0$  in structure PCC and

$\frac{dU_1}{dt_1} < 0$  in structure CPC in Table 5.4. Not only so, an increase of tariff rate in the small

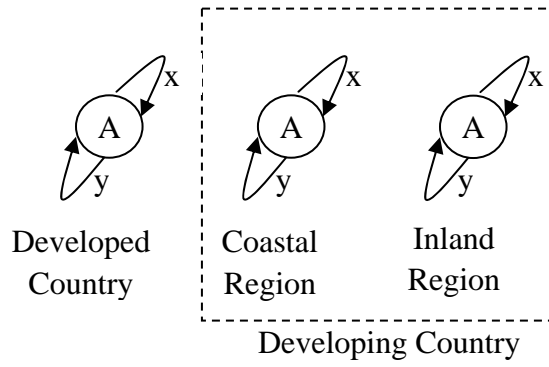
country will also hurt its trading partner, which can be seen that  $\frac{dU_1}{dt_2} < 0$  in structure PCC and

$\frac{dU_2}{dt_1} < 0$  and  $\frac{dU_3}{dt_1} = 0$  in structure CPC in Table 5.4. No country and region will benefit from

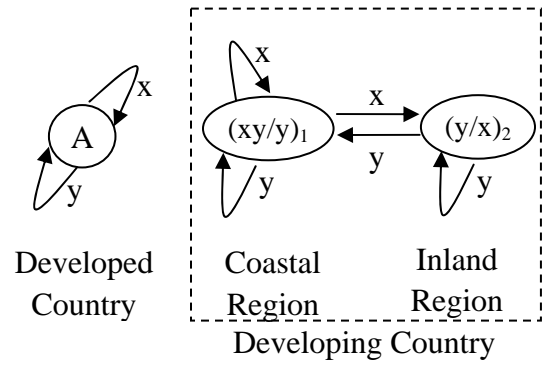
tariff increase in the small country. Thus, protection tariff policy is not available for a small country to improve their welfare given their negligible influence on terms of trade.

If the general equilibrium occurs in structure CCC in which both developed country and developing country have certain influence on terms of trade, both countries will enlarge their gains from trade if they increase their tariff rate given the tariff level in trading partner country, which can be seen that  $\frac{dU_1}{dt_1} > 0$ ,  $\frac{dU_2}{dt_2} > 0$  and  $\frac{dU_3}{dt_2} > 0$  in Table 5.4. However, this is at the expense of trading partner country since  $\frac{dU_2}{dt_1} < 0$ ,  $\frac{dU_3}{dt_1} < 0$  and  $\frac{dU_1}{dt_2} < 0$  in Table 5.4. Thus, tariff increase in the developed country will hurt the poor inland region in the developing country.

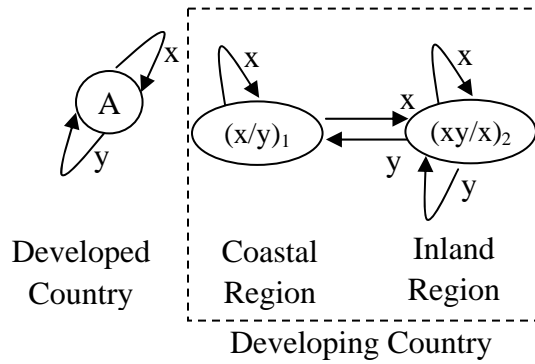
The story will be different if the government does not transfer tariff revenues to its residents, that is  $\mu_1 = \mu_2 = \mu_3 = 0$ . As shown in Table 5.5, Welfare of individuals in both rich coastal region and poor inland region in the developing country will not change as tariff rate change in both developed country and developing countries in structure CPC and structure CCC. However, if the developing country increases its tariff rate, the government would collect more tariff revenues. Thus, the developing country may have incentives to increase its tariff rate. But a tariff increase in the developing country will be opposed by the developed country because this hurts individuals there, which can be seen that  $\partial U_1 / \partial t_2 < 0$  in structure CPC and structure CCC in Table 5.5. Because an increase of gains from trade via protection tariff (either transferred to individuals in the country or solely reaped by the government as tariff revenues) is generally at an expense of another country, trade negotiation becomes necessary to determine the share of gains from trade of each country.



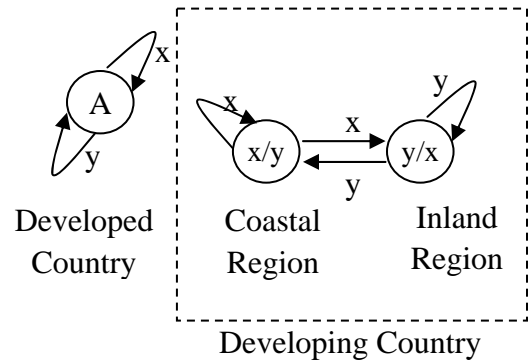
(1) Structure AAA



(2) Structure APC

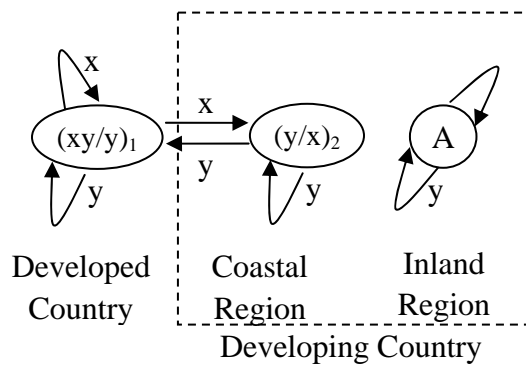


(3) Structure ACP

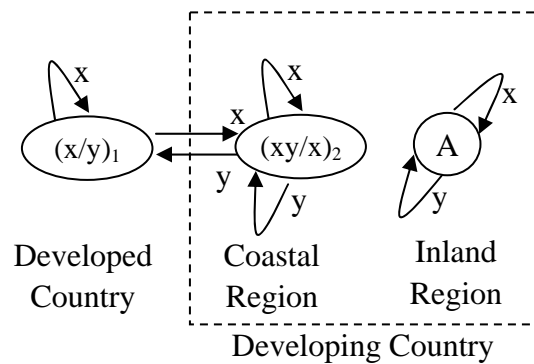


(4) Structure ACC

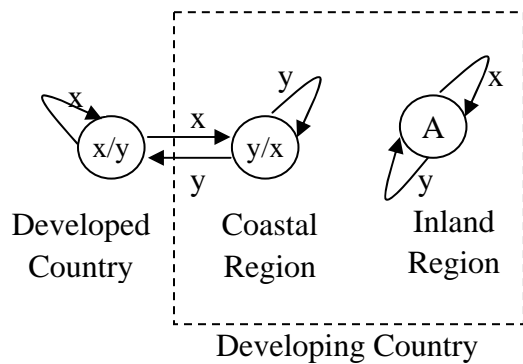
Figure 5.1: Configurations and market structures when international trade is absent



(5) Structure PCA

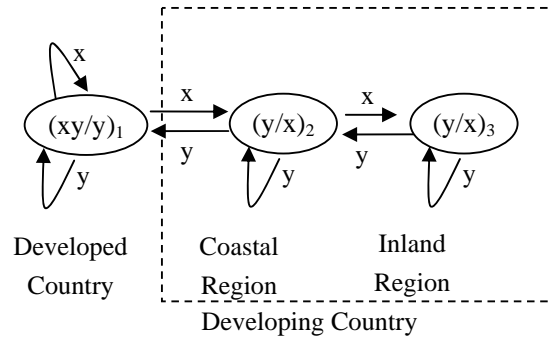


(6) Structure CPA

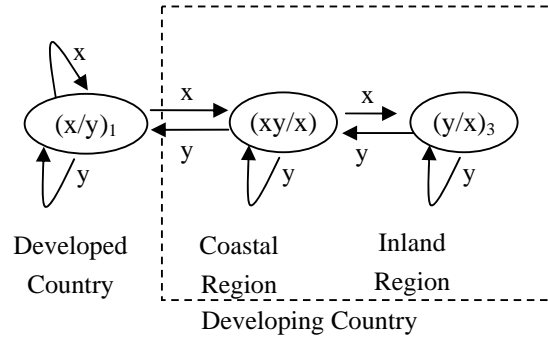


(7) Structure CCA

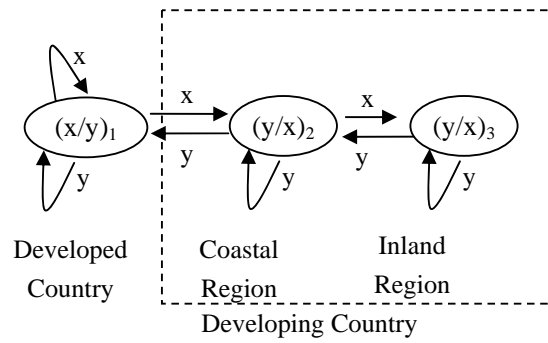
Figure 5.2: Configurations and Market Structures When the Inland Region is Excluded



(8) Structure PCC



(9) Structure PCC



(10) Structure CCC

Figure 5.3: Configurations and Market Structures with the Poverty Region in Trade

Table 5.1: Corner Equilibriums in 3X2 Ricardo Model :  $\mu_1 = \mu_2 = \mu_3 = 1$

Region	Structure PCC	Relative Price
Developed Country	$x_1^s = \frac{\alpha_{1x}(2l_{1x} - l)}{2 + t_1}, y_1^d = \frac{(1 + t_1)(2l_{1x} - l)\alpha_{1y}}{(2 + t_1)k_1}$ $U_1 = \frac{l + t_1 l_{1x}}{2 + t_1} (\alpha_{1x} \alpha_{1y})^{0.5}$ $l_{1x} = \frac{l}{2} + \frac{(2 + t_1)(M_2 \alpha_{2y} + (1 - M_2) \alpha_{3y}) k_1 l}{2(1 + t_1)(2 + t_2) M_1 \alpha_{1y}}$	
Coastal Region (Developing Country)	$x_2^d = \frac{l k_1 \alpha_{1x} \alpha_{2y}}{(2 + t_2)(1 + t_1) \alpha_{1y}}, y_2^s = \frac{\alpha_{2y} l}{2 + t_2}$ $U_2 = \left( \frac{l k_1 k_2 \alpha_{1x} \alpha_{2y}}{(1 + t_1)(2 + t_2) \alpha_{1y}} \right)^{0.5} \left( \frac{(1 + t_2) \alpha_{2y} l}{2 + t_2} \right)^{0.5}$	$p = \frac{(1 + t_1) \alpha_{1y}}{k_1 \alpha_{1x}}$
Inland Region (Developing Country)	$x_3^d = \frac{l k_1 k_2 \alpha_{1x} \alpha_{3y}}{(1 + t_1)(2 + t_2) \alpha_{1y}}, y_3^s = \frac{\alpha_{3y} l}{2 + t_2}$ $U_3 = \left( \frac{k_1 k_2 \alpha_{1x} \alpha_{3y} l}{(1 + t_1)(2 + t_2) \alpha_{1y}} \right)^{0.5} \left( \frac{(1 + t_2) \alpha_{3y} l}{2 + t_2} \right)^{0.5}$	



Table 5.1: Corner Equilibriums in 3X2 Ricardo Model:  $\mu_1 = \mu_2 = \mu_3 = 1$  (continued)

Region	Structure CPC	Relative Price
Developed Country	$x_1^s = \frac{\alpha_{1x} l}{2 + t_1}, y_1^d = \frac{k_2 \alpha_{1x} \alpha_{2y} l}{(1 + t_2)(2 + t_1) \alpha_{2x}}$ $U_1 = \left( \frac{\alpha_{1x} l (1 + t_1)}{2 + t_1} \right)^{0.5} \left( \frac{k_1 k_2 \alpha_{1x} \alpha_{2y} l}{(1 + t_2)(2 + t_1) \alpha_{2x}} \right)^{0.5}$	
Coastal Region (Developing Country)	$x_2^d = \frac{(1 - 2l_{2x})(1 + t_2) \alpha_{2x}}{(2 + t_2) k_2}, y_2^s = \frac{(1 - 2l_{2x}) \alpha_{2y}}{2 + t_2}$ $l_{2x} = \frac{l}{2} - \frac{(2 + t_2) k_2 M_1 \alpha_{1x} l}{2(1 + t_2)(2 + t_1) M_2 \alpha_{2x}} + \frac{(1 - M_2) \alpha_{3y} l}{2 M_2 \alpha_{2y}}$ $U_2 = \frac{l + t_2 l - t_2 l_{2x}}{2 + t_2} (\alpha_{2x} \alpha_{2y})^{0.5}$	$p = \frac{k_2 \alpha_{2y}}{(1 + t_2) \alpha_{2x}}$
Inland Region (Developing Country)	$x_3^d = \frac{(1 + t_2) \alpha_{2x} \alpha_{3y} l}{(2 + t_2) \alpha_{2y}}, y_3^s = \frac{\alpha_{3y} l}{2 + t_2}$ $U_3 = \frac{(1 + t_2) \alpha_{3y} l}{2 + t_2} \left( \frac{k_3 \alpha_{2x}}{\alpha_{2y}} \right)^{0.5}$	

Table 5.1: Corner Equilibriums in 3X2 Ricardo Model:  $\mu_1 = \mu_2 = \mu_3 = 1$  (continued)

Region	Structure CCC	Relative Price
Developed Country	$x_1^s = \frac{\alpha_{1x} l}{2+t_1}, y_1^d = \frac{p\alpha_{1x} l}{2+t_1}$ $U_1 = \left( \frac{\alpha_{1x} l (1+t_1)}{2+t_1} \right)^{0.5} \left( \frac{k_1 p \alpha_{1x} l}{2+t_1} \right)^{0.5}$	
Coastal Region (Developing Country)	$x_2^d = \frac{\alpha_{2y} l}{(2+t_2)p}, y_2^s = \frac{\alpha_{2y} l}{2+t_2}$ $U_2 = \left( \frac{k_2 \alpha_{2y} l}{(2+t_2)p} \right)^{0.5} \left( \frac{(1+t_2) \alpha_{2y} l}{2+t_2} \right)^{0.5}$	$p = \frac{(2+t_1)(\alpha_{2y} M_2 + \alpha_{3y}(1-M_2))}{\alpha_{1x} M_1 (2+t_2)}$
Inland Region (Developing Country)	$x_3^d = \frac{k_2 \alpha_{3y} l}{(2+t_2)p}, y_3^s = \frac{k_2 \alpha_{2y} \alpha_{3y} l}{(1+t_2)(2+t_2) \alpha_{2x} p}$ $U_3 = \left( \frac{k_2 k_3 \alpha_{3y} l}{(2+t_2)p} \right)^{0.5} \left( \alpha_{3y} l - \frac{k_2 \alpha_{2y} \alpha_{3y} l}{(1+t_2)(2+t_2) \alpha_{2x} p} \right)^{0.5}$	

Table 5.2: Corner Equilibriums in 3X2 Ricardo Model :  $\mu_1 = \mu_2 = \mu_3 = 0$

	Structure PCC	Structure CPC	Structure CCC
Relative Price	$p = \frac{(1+t_1)\alpha_{1y}}{k_1\alpha_{1x}}$	$p = \frac{p_x}{p_y} = \frac{k_2\alpha_{2y}}{(1+t_2)\alpha_{2x}}$	$p = \frac{M_2\alpha_{2y} + (1-M_2)\alpha_{3y}}{(1+t_2)M_1\alpha_{1x}}$
Developed Country	$x_1^s = \frac{\alpha_{1x}(2l_{1x}-l)}{2}, y_1^d = \frac{(2l_{1x}-l)\alpha_{1y}}{2k_1}$ $U_1 = \frac{l}{2}(\alpha_{1x}\alpha_{1y})^{0.5}$ $l_{1x} = \frac{l}{2} + \frac{(M_2\alpha_{2y} + (1-M_2)\alpha_{3y})k_1l}{2(1+t_1)(1+t_2)M_1\alpha_{1y}}$	$x_1^s = \frac{\alpha_{1x}l}{2}, y_1^d = \frac{lk_2\alpha_{1x}\alpha_{2y}}{2(1+t_1)(1+t_2)\alpha_{2x}}$ $U_1 = \frac{\alpha_{1x}l}{2} \left( \frac{k_1k_2\alpha_{2y}}{(1+t_1)(1+t_2)\alpha_{2x}} \right)^{0.5}$	$x_1^s = \frac{\alpha_{1x}l}{2}, y_1^d = \frac{p\alpha_{1x}l}{2(1+t_1)}$ $U_1 = \frac{\alpha_{1x}l}{2} \left( \frac{k_1p}{1+t_1} \right)^{0.5}$
Coastal Region (Developing Country)	$x_2^d = \frac{lk_1\alpha_{1x}\alpha_{2y}}{2(1+t_1)(1+t_2)\alpha_{1y}}, y_2^s = \frac{\alpha_{2y}l}{2}$ $U_2 = \frac{\alpha_{2y}l}{2} \left( \frac{k_1k_2\alpha_{1x}}{(1+t_1)(1+t_2)\alpha_{1y}} \right)^{0.5}$	$x_2^d = \frac{(2l_{2y}-l)\alpha_{2x}}{2k_2}, y_2^s = \frac{(2l_{2y}-l)\alpha_{2y}}{2}$ $l_{2y} = \frac{l}{2} + \frac{k_2M_1\alpha_{1x}l}{2M_2\alpha_{2x}} - \frac{(1-M_2)\alpha_{3y}l}{2M_2\alpha_{2y}}$ $U_2 = \left( \frac{(2l-l_{2y})l}{4} \alpha_{2x}\alpha_{2y} \right)^{0.5}$	$x_2^d = \frac{\alpha_{2y}l}{2(1+t_2)p}, y_2^s = \frac{\alpha_{2y}l}{2}$ $U_2 = \frac{\alpha_{2y}l}{2} \left( \frac{k_2}{(1+t_2)p} \right)^{0.5}$
Inland Region (Developing Country)	$x_3^d = \frac{lk_1k_2\alpha_{1x}\alpha_{3y}}{(1+t_1)(2+t_2)\alpha_{1y}}, y_3^s = \frac{\alpha_{3y}l}{2+t_2}$ $U_3 = \frac{\alpha_{3y}l}{2} \left( \frac{k_1k_2k_3\alpha_{1x}}{(1+t_1)(2+t_2)\alpha_{1y}} \right)^{0.5}$	$x_3^d = \frac{\alpha_{2x}\alpha_{3y}l}{2\alpha_{2y}}, y_3^s = \frac{\alpha_{3y}l}{2}$ $U_3 = \frac{\alpha_{3y}l}{2} \left( \frac{k_3\alpha_{2x}}{\alpha_{2y}} \right)^{0.5}$	$x_3^d = \frac{k_2\alpha_{3y}l}{2(1+t_2)p}, y_3^s = \frac{\alpha_{3y}l}{2}$ $U_2 = \frac{\alpha_{3y}l}{2} \left( \frac{k_3}{(1+t_2)p} \right)^{0.5}$

Table 5.3: Welfare Impacts of Technology in the 3X2 Ricardian Model

Structure	$\frac{\partial U_3}{\partial(\alpha_{1x}/\alpha_{1y})}$	$\frac{\partial U_3}{\partial\alpha_{2y}}$	$\frac{\partial U_3}{\partial\alpha_{3y}}$
PCC	+	0	+
	$\frac{\partial U_3}{\partial\alpha_{2x}}$	$\frac{\partial U_3}{\partial\alpha_{2y}}$	$\frac{\partial U_3}{\partial\alpha_{3y}}$
CPC	+	-	+
	$\frac{\partial U_3}{\partial\alpha_{1x}}$	$\frac{\partial U_3}{\partial\alpha_{2y}}$	$\frac{\partial U_3}{\partial\alpha_{3y}}$
CCC	+	-	+

Table 5.4: Welfare Impacts of Tariff Change in the 3X2 Ricardian Model ( $\mu_1 = \mu_2 = \mu_3 = 1$ )

Structure	The Developed Country		The Developing country			
			Coastal Region		Inland Region	
	$\partial U_1/\partial t_1$	$\partial U_1/\partial t_2$	$\partial U_2/\partial t_1$	$\partial U_2/\partial t_2$	$\partial U_3/\partial t_1$	$\partial U_3/\partial t_2$
PCC	+	-	-	-	-	-
CPC	-	-	-	+	0	+
CCC	+	-	-	+	-	+

Table 5.5: Welfare Impacts of Tariff Change in the 3X2 Ricardian Model ( $\mu_1 = \mu_2 = \mu_3 = 0$ )

Structure	The Developed Country		The Developing country			
			Coastal Region		Inland Region	
	$\partial U_1 / \partial t_1$	$\partial U_1 / \partial t_2$	$\partial U_2 / \partial t_1$	$\partial U_2 / \partial t_2$	$\partial U_3 / \partial t_1$	$\partial U_3 / \partial t_2$
PCC	0	0	-	-	-	-
CPC	-	-	0	0	0	0
CCC	-	-	0	0	0	0

**CHAPTER SIX**

**POLICY IMPLICATIONS, CONCLUSIONS,**

**AND FURTHER RESEARCH SUGGESTIONS**

**6.1. Policy Implications**

Our model of division of labor on poverty delineates the interdependent relationship between individuals in the poor inland region and the individuals in the rich coastal region and the developed country. Market integration (trade) plays a very important role in such interdependency. The division of labor and the extent of market integration (trade) depends on each other and reinforce each other. Thus, it is critical to develop the market and thus to improve the market transaction efficiency in the poor inland region.

Our model finds that as an important part of trade liberalization policy, tariff reduction may not always be a good policy choice for the developing country to alleviate the poverty in the inland region. Whether tariff reduction makes the inland region better off depends on the initial general equilibrium market structure and the power of the developing country influencing the terms of trade. If the developing country is large enough to determine the terms of trade in international trade with the developed country, the developing country may increase the welfare level of the poor inland region by increasing its tariff rate. But the developed country will oppose it because the tariff rate increase in the developing country will hurt its welfare. Trade negotiation is then necessary to determine the final tariff rate and the share of gains of trade accrued to each country and region.

In contrast to the large country position of the developing country in international trade, the small country can not use a protective tariff to improve its welfare. When all the countries have some influence on the terms of trade, the developing country can choose a protective tariff as a policy instrument to increase the welfare of the poor. Thus, population size matters to the poverty effects of trade liberalization. Due to its huge population size, China may have greater impacts on the world market equilibrium price than other developing countries. Thus, China's experiences in the trade-poverty relationship does not necessarily apply to other developing countries simply because of huge differences in population size.

Our model finds that relative productivity between the rich coastal region and the poor inland region affects individuals' welfare in the poor areas. In equilibrium, both coastal and inland regions export good  $y$ . The two regions have a competitive relationship in international trade. As the relative productivity gap between the two regions increases, individuals' welfare in the poor area will shrink. Different productivity levels are usually associated with regional inequality. Thus, our model supports Ravallion's view that initial inequality conditions affect how much the poor can share in the rising average income. During the past reform period, differential regional development strategy has contributed to the fast development in the coastal region, but also resulted in large regional inequality (coastal-inland inequality and urban-rural inequality). To make the poverty alleviation effort more effective, it is the time for the Chinese government to attack the issue of widening regional disparity. China's Western Development Strategy (WDS), adopted since September 1999, indicates that China is moving in this direction. At the top of China's WDS agenda are: transportation, telecommunications, energy, urban

infrastructure, forestry, mining, minerals, and agriculture. Special attention is also being paid to environmental protection, water conservation, and education reform. Over a ten-year period, the Chinese government expects to spend approximately \$200 to 250 billion US on these projects.

It is critical to develop the market and thus to improve the market transaction efficiency in the poor inland region. If the transaction efficiency of the inland region in the developing country is very low, the poor inland region may be excluded from domestic and international division of labor under an open-door policy and trade liberalization policy. However, under a close-door system or with high trade barriers (tariff and non-tariff trade barriers), the developed country may be excluded from international division of labor. The poor inland region then has the opportunity to join in domestic division of labor with the rich coastal region. Thus, an open-door policy or trade liberalization policy do not necessarily help lift the poor inland region out of poverty. The tiny share of the poor inland region in China's international trade indicates that the poor inland region is at the edge of being excluded from international trade. When the rich coastal region in China reaps large gains of international trade with the developed country, this will reinforce the rich coastal region to participate more division of labor with the developed country instead of with the poor inland region. As a result, this may leave the poor inland region further behind.

One may argue that increasing rural labor immigration from the poor inland region to the rich coastal region can enable the poor to participate in the division of labor. As suggested by Lewis's dual economy model, surplus labor in the traditional sector moves to the modern sector, providing incentives for economic development. However, due to the residential registration



system constraints in China, those rural labor workers immigrating into the coastal region can only have temporary residential status. There are huge discriminations against these rural workers. Many of them move from rural poor people to urban poor people. In addition, most of their family members still stay in the poor inland region. Without the development of the inland region, the Chinese government cannot successfully achieve its poverty alleviation goals because most of the poor in the inland region may be still excluded from domestic and international division of labor.

Improvement of transaction efficiency (i.e., transportation and information infrastructure, business skills) may provide a way for the poor inland region to get out of such exclusion from division of labor. However, it is a relatively long and gradual process to improve the transaction efficiency in the poor inland region. Thus, the developing countries should be careful about taking a “big bang” approach to of trade liberalization. Although China is not likely to take the “big bang” approach, the speed of opening-up is still an important research topic in order to buffer the negative impacts on the division of labor in the poor inland region.

As we refer transaction cost to any cost involved in market transactions, transaction efficiency is affected by many factors including infrastructure conditions, degree of urbanization, transportation conditions, communication conditions, and the general institutional environment. Our model shows that high transaction costs (low transaction efficiency) is the bottle-neck constraint on the poor inland region’s integration into international division of labor through international trade. With the low level of international and domestic trade, advanced technology embodied in traded goods cannot be diffused into the poor inland region. As Pfeffermann and

Fields commented,

“No single factor such as investment or education can ‘ignite’ development. Much depends, rather, on the pace at which poor societies can adapt knowledge that already exists in the more economically advanced parts of the world and put it to use. The challenge is how to bring about conditions in which knowledge accumulated over decades, and indeed centuries, can be usefully absorbed and effectively utilized in poorer countries.”

-- Fields and Pfeffermann, 2003. page 6

The low level of technology diffusion places a constraint on the productivity and economic growth of the poor inland region in turn. Geographic disadvantages are accentuated as the main barriers for the poor inland region in China to participate in division of labor to improve its technology level (Heilig et al., 2005). From the perspective of division of labor, those geographic disadvantages increase the transportation costs of goods and lower the transaction efficiency, thereby entrapping the labor division of the poor inland region into a low level in general equilibrium. However, we must be aware that transportation costs are only part of the transaction costs. More importantly, other factors including information technology and institutional environments may overcome the geographic disadvantages to promote market development in the poor inland region. As McCulloch et al. pointed out,

“Increasingly, informational failure are being recognized as a key constraint that the poor face. With little or no access to reliable information, poor households are likely to be extremely averse to taking actions to exploit opportunities when they cannot be sure that such opportunities are real.”

In today’s information age, information can be “transported” from the developed region to the poor region easily at a very low cost compared to goods transportation based on the existing telecommunication system. The poverty alleviation programs should take full advantage

of modern information technology to provide services (including marketing information, online education and health consulting) to the poor inland region so that it can get around the geographic barriers before an efficient infrastructure system in the poor inland region is built.

During the past two and a half decades of reform, the Chinese government has created the institutional climate to expand division of labor and to improve the market integration in China (Cai and Wang, 2003). Cai and Wang calculated a marketization index to measure the relationship between institutional reform and economic growth in China (Figure 6.1)<sup>1</sup>. The figure shows that the western inland region has seen a relatively slow market development and low division of labor which has not reach the extent to efficiently allocate resources. Thus, China's further reform and opening-up should lend a sustained impetus to market development and division of labor to exert comparative advantages of the inland region in order to alleviate the poverty in the inland region. The Chinese government should pay attention to the possibility that trade liberalization may crowd out the poor inland region from the division of labor, as we analyzed earlier.

## **6.2 Conclusions**

The relationship between trade liberalization and poverty alleviation in the developing country has been a hotly debated topic in economics research recently. This research endeavors to analyze the poverty impacts of trade liberalization from the perspective of division of labor.

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<sup>1</sup> The Marketization index is calculated by arithmetic average of share of trade in GDP, share of non-state-owned enterprises in total social commodity sales, share of non-state-owned enterprises in total social fixed assets investment, and share of non-state-owned enterprises in total output value of industry.

Since the majority of the poor in a developing country, i.e., China., usually cluster in the poor inland region, the welfare impacts of trade liberalization on the whole developing country do not necessarily reflect the true poverty impacts of trade liberalization. Thus, we refine our lens of poverty on the poor inland region by dividing the developing country into the poor inland region and a rich coastal region.

Our model considers division of labor as a fundamental characteristic of social economic activities. The poor in the inland region participate in interregional and international division of labor with individuals in the coastal region in the developing country and in the developed country. Due to different exogenous technological comparative advantages and constraints of transaction efficiency, division of labor in general equilibrium manifests itself at different levels. If division of labor in general equilibrium evolves from a lower level to a higher level, i.e., from a partial division of labor to a complete division of labor, individuals in the inland region will receive higher utility and thus have an opportunity to escape from poverty.

In the voluminous literature on poverty, the theory of division of labor on poverty can integrate all other theories. Any factors affecting poverty (poverty alleviation or poverty entrapment) at the individual, regional, national and international level will change the division of labor in the socioeconomic system and the associated welfare levels. Our model can accommodate theories analyzing impacts of geographic conditions, market integration and institutions (Diamond, 1997; Gallup et al., 1998; Sachs, 2001; Frankel and Romer, 1999; Sachs and Warner, 1995; Dollar and Kraay, 2004; North, 1990; Hall and Jones, 1999; Acemoglu et al., 2001; Rodrik et al., 2004). All these factors (geographic conditions, market integration and

institutions) influence transaction costs and transaction efficiency, and thus determine the general equilibrium division of labor and individuals' welfare levels.

At the micro level, individuals' and households' characteristics are also recognized as important factors determining their poverty status. From the perspective of division of labor, these micro factors (individual's gender, education, health, etc.) mean that different types of individuals have different transaction costs in market. Facing different transaction costs, individuals will make different optimum decisions of production and consumption and thus reach different general equilibrium levels in division of labor. Even though our current model assumes all consumers and producers are *ex ante* identical, we can apply the approach of division of labor by dividing individuals into different types according to their characteristics.

The theory of division of labor on poverty can thus integrate all theories analyzing poverty determinants at the macro, meso and micro levels. Transaction efficiency plays a key role in the theory of division of labor on poverty. The evolution process of division of labor usually involves improvements in transaction efficiency.

### **6.3 Suggestions for Future Research**

In this current version of the new classical trade-poverty model, we do not consider endogenous comparative advantage. The comparative advantage of production of one good is determined not only by the exogenous technology and resource endowments but also endogenous specialization. When there exist economies of endogenous specialization, the developing country may have endogenous comparative advantage but exogenous comparative

disadvantage in a good. If the endogenous comparative advantage in a good dominates, the developing country will export this good regardless of the exogenous comparative disadvantage in this good. More structures may then occur in general equilibrium and therefore much richer equilibrium mechanisms through which the poor inland region can grow out of poverty can be investigated.

We assume that all individuals are ex ante identical consumer-producers in each country and region. That is, the inland region consists of all ex ante individuals in poverty and the rich coastal region consists of all ex ante individuals not in poverty. Thus, we fail to investigate the poverty impacts of trade liberalization on the poor in the rich coastal region. We may assume that there are two groups of ex ante different individuals (poor and non-poor) in the rich coastal region to examine the poverty impacts of trade liberalization on the poor in both the inland region and the coastal region.

The poor often face a dilemma that they should choose consumption today to increase their current utility, or savings/investment today to increase their ability to guarantee future utility level. This is a dynamic instead of a static decision problem. Thus, another possibility for future research is to reformat individuals' decision problem into a dynamic optimization problem.

Compared to other households, poor households in the developing country are usually more vulnerable to serious shocks. Natural disasters such as flood, droughts, and market failures may have a longer and greater welfare impacts on poor households. Given different risk preferences, poor households may have different consumption preferences, technology adoption

preferences and investment preferences. Thus, another future research direction is to incorporate risk parameter into our trade-poverty model to examine how risk preferences affect the division of labor and thereby welfare of the poor.

There are an increasing number of rural workers mobilizing from the poor inland region to the rich coastal region in China since mid-1990s. Due to constraints of the current household registration system in China, most of them can only become temporary residents in coastal regions. These temporary rural workers send large amounts of remittances back to their family in the poor inland region. This round of rural workers mobilization and associated remittances are expected to have great impacts on poverty alleviation. Thus, a challenge to our model is how to incorporate labor mobilization and remittances endogenously into our model of division of labor.

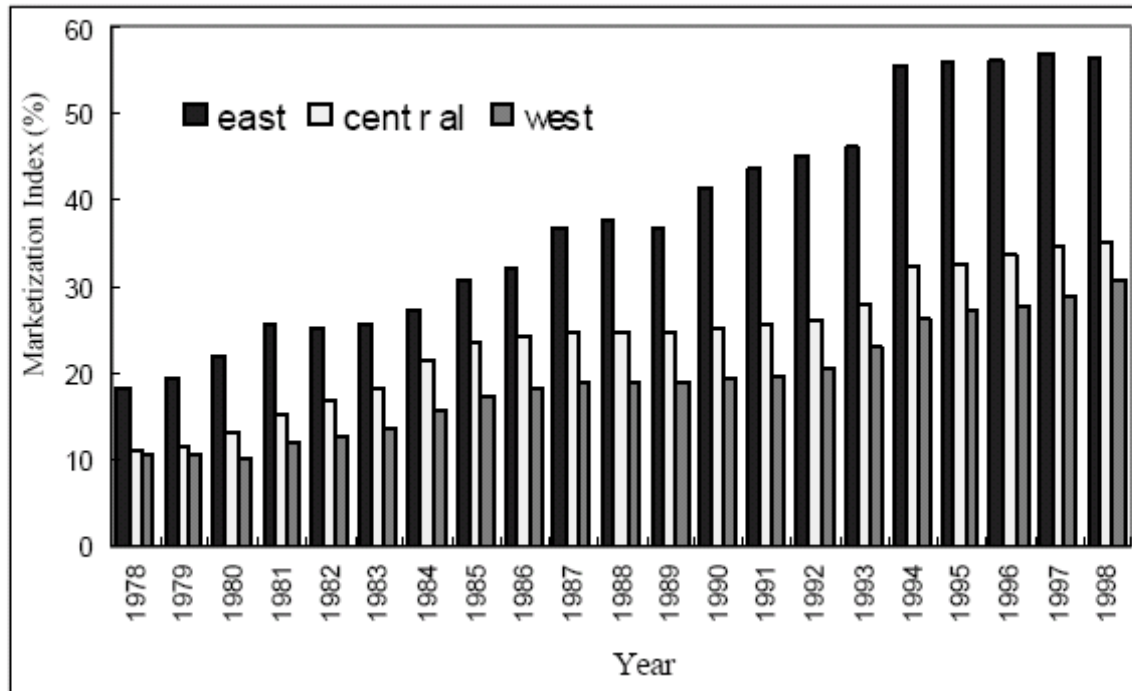
Another natural extension of our model is to develop a Heckscher-Ohlin (HO) model. In addition to resource endowments and technological comparative advantages, the HO model integrates capital endowment and accumulation into determination of a nation's exogenous comparative advantage. Thus, the HO model can be used to illustrate how the capital factor affects the poor inland region's participation in division of labor and associated welfare change in the absence of Ricardo's technological comparative advantage.

There already exists a large body of empirical work on poverty impacts of trade liberalization as mentioned in chapter 2. However, most work is in the spirit of neoclassical economics and few follows the spirit of new classical economics. This is because that new classical economics just emerged recently and the current econometrics methods are mainly designed for neoclassical economics. It is a challenging and rewarding area to develop

appropriate econometrics methods in a spirit of new classical economics in order to conduct empirical work on results from our new classical model.



Figure 6.1: Trend of Marketization Index by Regions in China: 1978-1998



Source: Cai and Wang, 2003.

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### TEACHING EXPERIENCES

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## **PUBLICATIONS IN REFEREED JOURNALS**

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Poverty.” Presented at the Western Economics Association International Annual  
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- Peng, Xuehua.** “Time Path of Grain Prices in Zhejiang Province.” Presented at the WCC-101 Annual Conference, Reno, NV in April, 2005.
- Peng, Xuehua** and Mary A. Marchant, Leigh J. Maynard and Yuewei Yu. “Price Liberalization or Control: A Test of Assumptions Influencing Chinese Grain Policy.” Presented at the East-West Center the 4<sup>th</sup> International Graduate Student Conference, Honolulu, Hawaii on February 17-19, 2005.
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- Peng, Xuehua** and Mary A. Marchant. “Spatial Price Linkages Between Chinese Regional Beef Markets.” Presented at the Southern Agricultural Economics Association (SAEA) Annual Meeting, Mobile, Alabama in February, 2003.
- Qin, Xiang Dong, **Xuehua Peng** and Mary A. Marchant. “New Insights on Chinese Livestock Consumer Preferences”, Presented at the American Agricultural Economics Association (AAEA) Annual Meeting, Long Beach, California in July, 2002.
- Qin, Xiang Dong, William Amponsah and **Xuehua Peng.** “The Case of Chinese Potential as a Major Market for U.S. Pork Exports”, Presented at the Southern Agricultural Economics Association (SAEA) Annual Meeting, Fort Worth, Texas in January, 2001.
- Qin, Xiang Dong, William Amponsah and **Xuehua Peng.** “Outlook of U.S. Poultry Exports to China”, Presented at the Southern Agricultural Economics Association (SAEA) Annual Meeting, Fort Worth, Texas in January, 2001.

Amponsah, William, Xiang Dong Qin, Victor Ofori Boadu and **Xuehua Peng**. “Management Perspectives on the Impacts of NAFTA on the U.S. Textile and Apparel Industries”, Presented at the American Agricultural Economics Association (AAEA) Annual Meeting, Chicago, Illinois in August, 2001.

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